DOCTOR OF PHILOSOPHY

Economic influences on and impacts of the migration of health professionals

Wang, Shaolin

Award date:
2010

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Shaolin Wang

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ECONOMIC INFLUENCES ON AND IMPACTS OF THE MIGRATION OF HEALTH PROFESSIONALS

SHAOLIN WANG

Submitted for
Degree of Doctor of Philosophy
Economic Studies
School of Business
University of Dundee
October 2010

DEDICATION

To my late father,

Xinzhong Wang

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LIST OF ABBREVIATIONS

ACGME:	Accreditation Council for Graduate Medical Education
ACT:	Additional Cost of Teaching
AHP:	allied health professionals
AIC:	Akaike Information Criterion
AKM:	Abowd, Kramarz and Margolis
CDS:	Community Dental Service
cloglog:	complementary log-log
CoT:	course of treatment
DGME:	Direct Graduate Medical Education
DiD:	difference-in-differences
DVT:	Dental Vocational Trainee
EEA:	European Economic Area
EPV:	events per independent variable
GDC:	General Dental Council
GDP:	General Dental Practitioner
GDS:	General Dental Service
GMC:	General Medical Council
GME:	Graduate Medical Education
GP:	General Practitioner
HCHS:	hospital and community health services
HDS:	Hospital Dental Service
HEI:	Higher Education Institution
IME:	Indirect medical education
IMG:	International Medical Graduate
KM:	Kaplan-Meier
LOWESS:	locally weighted scatterplot smoothing
MIDAS:	Management Information & Dental Accounting System
MPH:	mixed proportional hazards
NES:	NHS Education for Scotland
NHS:	National Health Service
NMC:	Nursing and Midwifery Council
ONP:	Overseas Nurses Programme
PH:	proportional hazards
PLAB:	Professional and Linguistic Assessment Board
PMETB:	Postgraduate Medical Education and Training Board
SDR:	Statement of Dental Remuneration
SFC:	Scottish Funding Council
USMLE:	United States Medical Licensing Examination
VT:	Vocational Training

ACKNOWLEDGEMENTS

This research was carried out at the Department of Economic Studies, University of Dundee, during 2006-2010. My deepest gratitude goes to my supervisors, Professor Martin Chalkley and Dr Colin Tilley for their comprehensive guidance, patience and support throughout these years. The thesis would not have been accomplished without their help and words alone do not do justice to them for all they have done through the time. My gratitude is due also to other faculty members for their helpful comments and continuous encouragements that helped me complete the study, in particular those of Dr Paul Allanson, Professor Hassan Molana, Dr Xiaoyi Mu, Dr Dennis Petrie, Dr Bill Russell, Dr Paul Seaman, and Dr Yin Zhang.

I am grateful to my student colleagues for their joyful companionship and my close friends for their support and understanding. All of them have made my life in Dundee colourful and fulfilled. A special thanks to Ms. June Campbell and Ms. Adele Ferrier for their excellent secretarial assistance.

Finally, but not least, I wish to thank my husband Long and my family, including my mother, my step father and my parents-in-law, for their understanding, encouragement and support that have made my education possible.

The financial support of the Department of Economic Studies is gratefully acknowledged.

Dundee, October 2010 Shaolin Wang

DECLARATION

I hereby declare that I am the author of this thesis. All references cited have been consulted, unless otherwise stated. All the work of which this thesis is a record has been done by myself. It has not been previously accepted for a higher degree.

Signed……………………………………
Name: Shaolin Wang, PhD Candidate
Date………………………………………

CERTIFICATION

This is to certify that Ms. Shaolin Wang conducted her research under my supervision in the Department of Economic Studies, University of Dundee. Ms. Wang has fulfilled all the conditions of the relevant Ordinances and Regulations of the University of Dundee for obtaining the Degree of Doctor of Philosophy.

Signed……………………………………
Name: Martin Chalkley, Supervisor
(Professor of Economics)
Date………………………………………

ABSTRACT

Migration has become an important feature of health labour markets due to the global shortage of health professionals. While there exists an extensive Labour Economics literature studying the general migration, policy development remains hampered by limited research undertaken in the health sector. This thesis fills some of that gap by examining the economic influences on and impacts of the migration of health professionals.

The migration of skilled health professionals has exhibited strong sectoral properties, such as the motivation of career development and various regulatory regimes. We incorporate these features into the self-selection model by Borjas and Bratsberg (1996) and examine factors that influence the scale and skill composition of the migration flow. Our model suggests that the restrictive relicensing regime and work permit requirements for non-EEA professionals adopted by the British government to maintain practice standards and secure employment opportunities for native graduates, could only limit the migration from countries with higher returns to skills. The effect is ambiguous for most donor countries, which provide lower returns to skills.

Using the administrative data derived from the Scottish dental system, we also examine the impacts of health professional migration within EU on the host country by investigating the performance of EEA dentists contracted under the Scottish NHS in terms of retention and treatment provision. A discrete-time survival analysis has been applied to characterize the time trend of the retention and identify factors associated with the likelihood of a dentist leaving the NHS. We also compare treatments provided by migrant and non-migrant dentists by estimating a difference-in-differences model. Unobserved heterogeneity in dentists is controlled using fixed effects.

Our results suggest that EEA health professionals can be a good substitute to British graduates. They provide marginally different treatments and exhibit strong assimilation within two years post-entry. However, a constant issue we have found is their high turnover rates in the NHS: half of them left the service by the 26th month following entry. The primary policy recommendation of our analyses is that there is need for the government to develop recruitment initiatives so as to retain migrant dentists. Our results suggest hazards of leaving are significantly associated with dentists' age-at-entry, arrival cohort and patient composition, but not with dentists' gender, country and practice deprivation. These findings potentially help to set evidence-based targets for international recruitment programmes.

CHAPTER 1
INTRODUCTION

To address the global crisis in the health workforce, OECD countries have adopted a mix of long-term policies of national self-sufficiency (e.g. increasing domestic training, improving retention, and adapting skill mix), and short or medium-term policies of international recruitment. Migrant health professionals have proven to be a flexible and low-cost response to shortages and make a significant and escalating contribution to health care labour markets in industrialized countries. In 2000, there were approximately 400,000 migrant doctors and 710,000 migrant nurses working in the OECD area (OECD, 2008). The United Kingdom, in particular, has become a major destination of migrant health professionals, with 33% (69,813) of the doctors and 10% (65,000) of the nurses working in 2006 qualified overseas (WHO, 2006).

Migration, therefore, becomes an important feature of health labour markets, being high on the health policy agenda for both donor and host countries. For donor countries, the ultimate aim is to improve retention and encourage emigrants to return thus minimising the brain drain and losses of public health sector investment. In the labour-intensive health sector, loss of health professionals presents serious challenges to the quality of health service delivery to the population, and also, increases work burdens and worsens working conditions for the remaining health providers, which could in turn induce further emigration. From host countries' perspective, on the other hand, while international recruitment becomes an increasingly popular short term adjustment to the workforce imbalance, OECD (2008, pp. 36) lists a series of "side effects" that need to be addressed, including "problems related to the integration of immigrants into health workforce (such as the recognition of foreign qualifications and language proficiency); costs of international recruitment, especially when migration is mainly temporary; difficulties in retaining doctors and nurses in less attractive locations and positions; and the risk of becoming excessively dependent on foreign health professionals to fill domestic needs".

Despite the importance attached to migration in the health sector, policy development remains hampered by limited, mostly descriptive, research undertaken in this field. For example, although push and pull factors that influence the migration decisions of health professionals are well documented in the health policy literature, the extent to which these factors affect the decisions are rarely addressed (Vujicic *et al.*, 2004); in addition, whilst the impact of health professional migration on outcome is important, existing research mainly focuses on the quantitative effects rather than qualitative effects (Bach, 2003). While there exists an extensive literature on general migration addressing three particular issues: "1) what determines the size and skill composition of immigrant flows to any particular host country; 2) how do the immigrants adapt to the host country's economy; and 3) what is the impact of immigrants on the host country's economy?" (Borjas, 1989, pp. 457); this literature is not applied to the issue of health professional migration. This study aims to fill these gaps and specifically seeks to meet the following three objectives.

The first objective is to analyse the migration and permanent residence decision of health professionals, and influences on the direction, scale and skill composition of the migration flow in a theoretical model framework. Unlike other workers who generally migrate for income maximization, the migration of skilled health professionals has demonstrated strong sector-specific characteristics, e.g. the motivation of career development (George *et al.*, 2007), and a strict relicensing and regulatory regime (Bach, 2003; Commander, Kangasniemi and Winters, 2002; Manning and Sidorenko, 2007). The strict regulatory regime is a particular feature of the migration in the health sector: host countries generally set out restrictive requirements for relicensing and registration to control the entry and guarantee the practice standards of migrant health professionals. These could however, be overly restrictive and thus would deter potentially competent health professionals from migrating. Assessing the impact of regulatory regimes on health professionals' migration decisions is clearly a concern for public policy. We account for these sector-specific factors in health professionals' migration and permanent residence decisions by developing the self-selection model by Borjas and Bratsberg (1996). A comprehensive understanding of health professionals' migration and return decisions is essential to develop policies regulating and controlling migration in- and outflow.

Having analysed the reasons behind, our next issue to address is the impacts of health professional migration. Using administrative data derived from the Scottish dental system, we target a particular group of migrant health professionals – dentists migrating from the European Economic Area (EEA) countries and contracted under the Scottish National Health Service (NHS). Migration within the European Union has attracted considerable attention: registration requirements are relaxed with qualifications in member states automatically recognized, which, together with great salary disparities between EEA countries, encourage more professionals to move. OECD (2008) documents the growing within-migration flows since the May 2004 and December 2007 European Union enlargements, and calls for a systematic analysis of the trends and consequences. We evaluate the impact of the health migration within the EU on the health care provisions in the host country by looking at a specific case where we investigate the performance of EEA dentists in the Scottish NHS in terms of retention and treatment provision.

The second objective is to characterize the time trend of retention for EEA dentists in the Scottish General Dental Service (GDS) and identify factors associated with the likelihood of a dentist leaving the service. Effective workforce planning requires good information on migrant health professionals' retention patterns and influences on these (Hann, Sibbald and Young, 2008). We carry out multivariate analysis in a mixed discrete-time proportional hazards framework to assess the importance of four dimensions of variables in the underlying utility function that governs each dentist's stay-or-leave decision (e.g. dentist personal characteristics, practice characteristics, patient composition and dentist overall treatment provision), while controlling for random unobserved heterogeneity.

There are obvious questions regarding the transferability of health education in EU member countries, and in the realm of health care, where in the presence of asymmetric information health care professionals have considerable discretion over the type of care they deliver, this raises concerns regarding both the quality and safety of healthcare (OECD, 2008; Simoens and Hurst, 2006). The final objective is to compare empirically the treatments delivered by migrant and domestically trained dentists working in the Scottish GDS. We choose the group of EEA dentists who started providing treatment in the service after 2006 and the 2005/06 cohort of Scottish Dental Vocational Trainees (DVTs) for comparison so as to compare the outputs of the government recruited migrant General Dental Practitioners (GDPs) with the outputs of local graduates who entered the service at the same time. A difference-in-differences model is estimated to examine how migrant dentists' responses to different case mix and individual circumstances (treatment category, patient type, remuneration, etc.) compare with non-migrant dentists' responses, and in particular, whether there is a convergence between the two groups of dentists as migrants assimilate into the host country. Given the longitudinal nature of the data, we control for time-invariant unobserved heterogeneity in dentists using the fixed effects method. However, the dentist fixed effects method cannot identify the initial treatment difference and assumes homogeneous patients that unobserved dentist-specific characteristics affect treatment delivery in the same way for all patients. These two limitations are addressed by estimating an auxiliary OLS regression of dentist effects estimated to isolate the fixed effect of migrant status, and, making full use of the matched patient and practitioner data to simultaneously control for patient- and dentist-specific effects using a three-way error-component model.

The rest of the thesis is organized as follows. Chapter 2 provides the institutional and policy background by describing the structure and finance of domestic training, and the numbers, reasons and regulatory regimes of international recruitment across countries. Chapter 3 investigates the individual migration and permanent residence decision of healthcare professionals using an extended self-selection model which allows for the sector-specific properties of health professional migration documented in Chapter 2. The extent to which current regulatory regimes implemented in the UK affect the size and skill composition of (permanent) health migration inflows is assessed as a case study. Chapter 4 provides the data source for the following two empirical analyses and the institutional background for the dental service provision and international recruitment in the Scottish NHS. Descriptive statistics are presented to investigate the inflow of dentist from EC/EEA countries and their individual characteristics and career patterns. Chapters 5 and 6 are where we conduct empirical analysis to investigate EEA dentist performance in the Scottish GDS. Chapter 5 examines the retention patterns of these dentists and identifies factors that influence their retention decisions using the discrete-time hazard modelling approach. Chapter 6 compares the treatment provided by migrant and non-migrant dentists by estimating a difference-in-differences model where we control for unobserved heterogeneity in dentists using fixed effects estimation method. The last chapter concludes.

CHAPTER 2

INSTITUTIONAL AND POLICY BACKGROUND: POLICIES TOWARDS THE SUPPLY OF HEALTH PROFESSIONALS

2.1 INTRODUCTION

To provide the institutional and policy background for subsequent analysis, this chapter describes key features of the finance of domestic training and regulatory regimes of international recruitment for health professionals across countries.

A global crisis in the availability of well-trained health professionals has been identified as an obstacle to achieve national and global health goals in the world health report "Working together for health" (WHO, 2006). As a result of the aging of populations, the transition of health concerns from acute diseases to chronic and degenerative ones with higher care demands represents further health workforce challenges (Pruitt and Epping-Jordan, 2005). Based on the WHO estimate of a threshold in workforce density below which high coverage of essential interventions are very unlikely to achieve, there are 57 countries, particularly in sub-Saharan Africa and South-East Asia, struggling with critical workforce shortage equivalent to a global deficit of 2.4 million doctors, nurses and midwives (see Table 2.1).

Table 2.1: Estimated critical shortage of doctors, nurses and midwives, by WHO region.

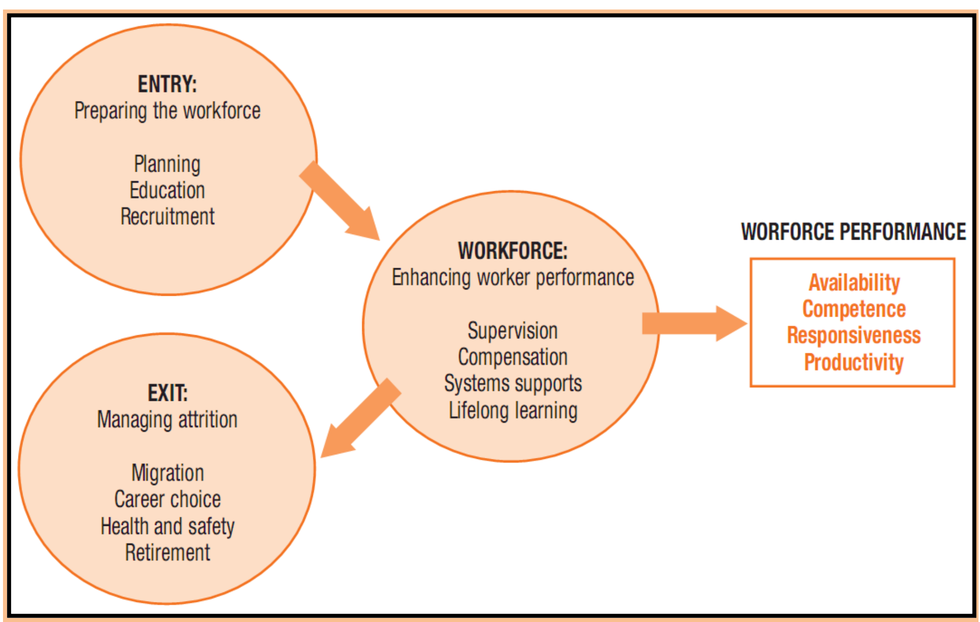
WHO region	Number of countries		In countries with shortages		
	Total	With shortages	Total stock	Estimated shortage	% increase required
Africa	46	36	590 198	817 992	139
Americas	35	5	93 603	37 886	40
South-East Asia	11	6	2 332 054	1 161 001	50
Europe	52	0	NA	NA	NA
Eastern Mediterranean	21	7	312 613	306 031	98
Western Pacific	27	3	27 260	32 560	119
World	192	57	3 355 728	2 358 470	70

NA, not applicable
Source: Working together for health (WHO, 2006), page 13.

In order to respond to these skills crises, the report lays out a "working lifespan" framework which specifies strategies related to the following three stages (see Figure 2.1):

- Entry: preparing the workforce through strategic investments in education and effective and ethical recruitment practices.
- Workforce: enhancing worker performance through better management of workers in both the public and private sectors.
- Exit: managing migration and attrition to reduce wasteful loss of human resources.

In particular, the fundamental objective of workforce development is to prepare sufficient numbers of qualified health professionals to meet the national demand of health care. It is the strategies pertaining to the entry stage, more specifically on the domestic training and international recruitment, that are the subject of this chapter.



Source: Working together for health (WHO, 2006).

Figure 2.1: Working lifespan strategies.

2.2 DOMESTIC EDUCATION AND TRAINING FOR HEALTH PROFESSIONALS[1]

Given that we use data derived from the Scottish dental system for the subsequent empirical analyses, we focus on several key issues within the system of training health professionals in Scotland[2], and describe how other OECD countries with available information approach them. These issues are: how the system of health care is funded; how the number of undergraduate training places is determined; how undergraduate training is funded; how the clinical costs of undergraduate training are funded; how postgraduate medical education is funded; and what policies have been used to influence the geographical distribution of the workforce.

It shows that different countries adopt a variety of approaches to the structure and finance of health training. While it is tempting to make comparisons between different elements of training across countries, whether the approach adopted in Scotland is better or worse than in other countries is difficult to assess because the structure and finance of training reflects the objectives and constraints of each country in which the training and employment of health professionals is located, and these objectives and constraints are likely to differ significantly between countries. As a result, this section has deliberately limited itself to describing a number of features of the system in different countries. By describing how different countries approach the structure and finance of health training, we identify the possible set of instruments available that may improve the outcomes of the training system in Scotland.

[1] This research is funded by NHS Education for Scotland and the Scottish Funding Council to contribute to the SFC Skills Committee's discussions of the framework within which health training is provided in Scotland.

[2] While the details of the training system that we discuss here relate to the NHS in Scotland but the organisational structure, funding methods and funding rates apply equally to the NHS in England and Wales.

The review was approached in a systematic way with well-defined search terms used to trawl the literature. Unfortunately, the literature did not contain all the detailed information required for this survey on an individual country or countries. As a result, various different types of documents were trawled through looking for pieces of information within documents written for other purposes that might inform this review, including academic papers, policy documents and training guides for health professionals. All relevant documents were identified and useful references followed up.

2.2.1 Background

Training for health professionals is different from other professional groups in terms of its structure, finance and cost.

One way in which the structure of health training is different from other forms of professional training is the integrated nature of training and employment. The structure of education and training for physicians across different countries is presented in Table A2.1. The public sector funds the undergraduate and postgraduate training of health care professionals and the public sector is also the employer or payer (for independent General Medical Practitioners and General Dental Practitioners) of the vast majority of trained labour. This differs from other professionals who are more likely to work in the private sector after graduation. The extent of this integration might be of interest if it explains differences in the features of training across countries. For example, the degree of integration might explain why there are restrictions on training for doctors, dentists and nurses.

The finance of health training courses differs from all other undergraduate training courses. In Scotland, undergraduate training is provided by both the Higher Education Institutions (HEIs) and NHS Boards. Whilst the Scottish Funding Council (SFC) allocates funding to HEIs at a fixed price per final funded student, NHS Education for Scotland (NES) allocates funding directly to NHS Boards in order to compensate them for the additional costs of teaching. Learning to Care (SFC and NES, 2008) reported that there have been concerns about the accountability of these funds. Thus, there is some interest in alternative methods of funding (clinical and non-clinical) providers. There may also be concerns that subsidies to clinical training might distort the composition of training courses because of incentives for HEIs to shift the balance of training from non-clinical to clinical training. Differences in the nature of funding might therefore explain differences in the relative amount of clinical and non-clinical training.

The cost of training health professionals to the public sector in Scotland is substantial. Learning to Care (SFC and NES, 2008) recently published that in the academic year 2007-08, SFC provided £160 million to universities for the training of doctors, dentists, nurses and allied health professionals (AHPs) and for health-related postgraduate courses. In addition, NES provided more than £343 million for the training and education of doctors, dentists, clinical psychologists, pharmacists, nurses, midwives, AHPs and other staff groups working in NHS Scotland. This significant public sector investment in the training health professionals means that there is some interest in identifying how other countries finance training.

2.2.2 Finance of training for health professionals

The funding of health care provision

The funding of health care provision is likely to have important implications for the structure and finance of training for health professionals. If health care systems are mainly funded by the public sector, and therefore employ or contract trained health professionals, then the public sector is concerned with the costs of employment. These costs may impact on whether, and to what extent, the public sector chooses to influence the structure and finance of training. For example, if the public sector funds the training of health professionals and is the purchaser of trained health professionals, it may more likely restrict the number of funded training places compared to a system in which the private sector provides training and delivers health care. However, this depends on the extent to which the public sector funds training.

Bloor and Maynard (2003) provide a summary of the finance and delivery of health care in five countries (Australia, France, Germany, Sweden and the UK) and show that while the majority of health care was funded by the public sector in all countries, the system of funding, the nature of the providers of health care and the payment systems between purchasers and providers vary between countries.

In France, the health care system is funded through health insurance, financed mainly by the social security contributions of residents in employment and supplemented by funds from taxation. Health care is provided by a mix of public (about 65% of hospital beds) and private providers (Wait, 2006).

In Germany, the health care system is financed through a system of statutory health insurance covering almost 87% of the population, and around 10% of the population covered by private health insurance. An additional mandatory insurance programme ensures access to nursing care for elderly people. Regional physicians' and dentists' associations negotiate contracts with the different sickness funds that operate in their state and distribute the financial resources they receive among their members. Ambulatory care is mainly provided by private providers working in single practices. Patients are able to choose between doctors, dentists and pharmacists (Weinbrenner and Busse, 2006).

Norway's health care system is predominantly financed through general taxation and, to a lesser degree, through out-of-pocket payments. General Practitioners and hospital doctors are either directly employed by the public sector or are independent contractors with their remuneration determined by the public sector and the Norwegian Medical Association (Brenne, 2006).

In Poland, the health care system is financed through compulsory health insurance. Individuals contribute 7.75% of their taxable income, and the public sector funds individuals on low income. Initially the system was organised through regional sickness funds but from 2003, they were amalgamated to create a National Health Fund. There is a mix of public and, increasingly, private sector providers (Stróżik, 2006).

The number of undergraduate training places

The difficulties of workforce planning for health professionals were identified in Learning to Care (SFC and NES, 2008). These difficulties are not unique to Scotland: OECD (2008) reports that many OECD countries faced nursing and medical shortages towards the end of the 1990s and Bloor and Maynard (2003) reports that several countries have experienced cycles of shortages and surpluses, particularly in nursing.

One of the key determinants of the supply of health professionals is the number of undergraduate training places. In general, the optimal number of undergraduate places depends upon the costs and benefits of training. The costs of training include, among other things, the cost of training to the HEI, the cost of employment, the proportion of the tuition fee paid by students and whether training and/or employment is funded by the public sector. Differences in the benefits, costs or source of funding between countries are likely to generate differences in the optimal number of undergraduate places.

In Scotland, the number of places is set either by the public sector (medicine, dentistry and nursing), or by the minimum of the supply of by HEIs and demand for places by students (other health professions). One alternative approach would be to allow HEIs to charge fees for places and allow the fee to equate supply and demand. Another alternative approach would be to consider forms of funding other than the current fixed price mechanism. For example, despite persistent excess demand for places from suitably qualified applicants, the number of undergraduate places on medical and dental courses in Scotland is restricted. Allowing the number of training places to be determined by the demand for and supply of places under a fixed price mechanism would be a costly proposition for the public sector. Therefore, the public sector may want to consider changing the system of funding.

Moreover, the number of training places is likely to be a function of amount and type of funding. For example, in some countries, the public sector funds a limited number of places, and does not control the total number of places. Simoens and Hurst (2006) and OECD (2008) report the extent to which places for undergraduate medical training are controlled. Australia, Belgium, Canada, France, Greece, Japan, the Netherlands, New Zealand, Norway, Spain and Sweden all operate some form of *numerous clausus* arrangements that control the number of medical school places. In Austria, Germany, Ireland, Korea, Switzerland and the US the number of places at medical school is not controlled. Simoens, Villeneuve, and Hurst (2005) and OECD (2008) report the extent to which places for undergraduate nursing training are controlled. In Australia, Belgium, Mexico, Netherlands, New Zealand, Norway and the United States, the number of nursing places is determined by nursing schools. The public sector funds some of these places. In Austria, Canada, England, Germany, Greece, Ireland, Japan, Korea, Slovak Republic, Spain, Sweden and Switzerland, the number of training places is controlled by the public sector.

More specifically, regardless of whether undergraduate places are controlled or not, there is variation in the amount of public sector subsidy:

- In Norway, Brenne (2006) reports that the public sector has successfully used the level of tuition fee scholarships to influence the number of physiotherapists and doctors. There are no tuition fees for undergraduate training. In addition, Norwegian students receive loans and grants in order to fund their education. If students graduate within a certain period of time, part of their loans are converted into a grant.
- In Poland, the public sector funds a limited number of undergraduate places but additional places are available for self-funded students. This mixed system is believed to have caused a large number of graduates, many of whom have difficulties finding employment (Stróżik, 2006).
- Ireland has a limit on the number of EU undergraduate medical students but there is no limit on the number of non-EU fee-paying students. In 2003, it was estimated that non-EU medical students accounted for 62% of the new student intake and 83% of student related income (Department of Health and Children, 2006; Finucane and Kellett, 2007).
- In Australia, all students pay fees. However, some student places are subsidised by the public sector. The extent of this subsidy depends upon the training course and whether the profession, for example nursing, is deemed to be a national priority area. Fees can be paid up-front, in which case students receive a discount, or as a graduate tax. For example, at the University of Melbourne, Australian full fee

paying students will pay over A$40,000 for a standard full time course load. By contrast, a subsidised place costs A$8,500. The number of subsidised places is determined by the public sector (Australia Universities, 2007; Metz, 2004).

- In the US, medical school tuition fees are set either by the medical school, the Board of Trustees of the university or by a state authority (20%). Students fund their tuition fees through scholarships or loans.
- In Japan, the majority of the costs of training are funded by the public sector (about 44%) and students (about 40%) (Ban, 2005).

Simoens and Hurst (2006) and OECD (2008) find that the density of doctors is higher in countries where the number of undergraduate medical school places is not controlled.

Additional Costs of Teaching

Undergraduate pre-registration clinical training imposes additional costs such as the use of hospital facilities and staff. In Scotland, the public sector compensates NHS Boards for the Additional Cost of Teaching (ACT) medical and dental students but does not compensate NHS Boards for the additional costs (if any) of training nursing or AHP students. ACT is allocated by NES from the Education budget.

A couple of concerns have been raised around ACT (in England, the Service Increment for Teaching). First, because the clinical training of undergraduate students is produced jointly by HEIs and NHS Boards, ensuring the accountability of ACT and SFC funds is difficult and imposes significant costs on NES, HEIs and NHS Boards. Second, subsidising clinical training in this way provides incentives for HEIs to place a greater emphasis on clinical training than they otherwise would.

An alternative approach to overcome both these concerns would be to allocate ACT directly to HEIs and allow HEIs to contract with NHS Boards around the use of their staff and facilities.

There is substantial variation in the funding of undergraduate clinical training in other countries.

- In Germany, practice-based education is generally funded by the insurance funds as part of their contracts with individual hospitals (Weinbrenner and Busse, 2006). The clinical training of nurses used to be the responsibility of the public sector but is expected to be financed in the future by a surcharge on treatment costs (Busse and Riesberg, 2004). While in the past, there has been cross subsidisation between clinical and academic budgets, the separation of funding, as required by law, has recently been enforced (Pietz *et al.*, 2002).
- In Ireland, there is no distinct source of funding provided by the Department of Health and Children to hospitals or primary care facilities, to compensate them for the costs of undergraduate clinical training. Undergraduate medical training is indirectly funded by medical staff devoting a proportion of their time to training students on clinical placements. Hospitals may also receive recurrent and capital funding through agreements in place with the medical schools. These include agreements involving the refunding of hospitals for staff costs associated with training. Medical schools may pay for specific infrastructure and facilities located in the hospitals and which are geared towards medical training. However, this does not apply to all hospitals and where it does, it may not always be consistent (INDECON, 2005). Department of Health and Children (2006) reports that it believes it is essential that hypothecated funding be provided for undergraduate clinical training

and suggests that while the funding should be allocated by the public sector directly to the Health Service providers, it is equally essential that the medical schools can influence how such funding is utilised in order to ensure effective and high quality teaching in line with curriculum requirements.

- In Australia, public hospitals may receive some payment from universities for the use of their facilities for clinical training purposes. Indeed, there is an explicit clinical training component in the Government's contribution to medical and nursing course costs. Also, provision has been made for clinical training provided to nurses. However, for allied health courses, there is no separately identified clinical training component in government funding. Hence, universities must meet the cost of any payments to public hospitals (or other training providers) from general funding sources.
- In Norway, the public sector is responsible for providing students of nursing, medicine and other health professions with clinical training. Some HEIs have had difficulties in finding enough clinical training placements for their students because of the lack of incentives for the clinical training providers. The public sector plans to instruct clinical training providers to offer clinical training placements (Brenne, 2006).

The funding of postgraduate medical education

Health training in general and medical training in particular is one of the few professions to have a substantial amount of postgraduate training. A significant amount of public sector funding in Scotland is allocated to supporting postgraduate medical education in the form of salaries for doctors in training (Foundation Year doctors and Specialist Trainees). In effect, the public sector subsidises the cost of employing doctors in training. One reason for this public sector subsidy might be the concern that NHS Boards would have few incentives to train staff and, instead, divert resources to service delivery.

An alternative way of funding postgraduate training might be for the trainees to pay either directly, through fees, or indirectly, through a relatively low training wage.

- In Germany, medical trainees receive a relatively low wage during postgraduate training. Some of the costs of postgraduate medical education are borne by both the public and private sector. Sickness funds and private insurers indirectly support education through paying higher patient care costs to teaching hospitals and, along with regional physicians' associations, also finance half of the salaries for general practitioners trainees during their practice-based training period (2-3 years). In addition, the public sector is responsible for the budgets of hospitals so also indirectly subsidises postgraduate medical education (Wynn *et al.*, 2006).
- In Poland, doctors compete for employment posts as residents. Residency training is financed by the public sector. Residents are employed for the entire duration of their specialty training (Kuszewski and Gericke, 2005).
- In Ireland, the Department of Health and Children (2006) reports that the evolution of postgraduate medical education and training in the absence of an integrated national strategy for medical education and training has resulted in a fragmented system and that the lack of hypothecated training allocations has led to inadequate investment in medical education and training.
- In Australia, Australian Government Productivity Commission (2005) reports that funding for hospital-based clinical training comes from a variety of disparate sources and is not always separately identified. This lack of explicit payment for many clinical training services makes the funds vulnerable to competing service

needs. The public sector funds General Practice training through a much more explicit and transparent framework. Australia has found that a lack of hypothecated funding for clinical training has meant that training in the public and private sector has decreased.

- In Canada, postgraduate medical education funding is provided for every Canadian medical school graduate but the number of funded training posts often increases to cover international medical graduates. Canada sends direct Graduate Medical Education (GME) funds, for residents' and teaching physicians' salaries and teaching physicians, to the medical school and requires that all GME programs be based at a medical school, rather than at a hospital (Wynn *et al.*, 2006).
- The US provides an enormous amount of information on the structure and finance of postgraduate medical education. For a detailed overview see Wynn *et al.* (2006). Postgraduate medical education in the US is funded through two components: direct and indirect Graduate Medical Education (GME). Direct GME (DGME) costs are those costs that are directly attributable to the teaching activity, such as resident stipends, teaching physician compensation, and administrative costs and administrative overhead. Indirect medical education (IME) costs are higher patient care costs associated with having GME programs that cannot be directly attributed to the teaching program. Residents agree to a relatively low wage in return for higher wages in the future. GME is funded through a number of sources but Medicare[3] is the largest single contributor. Medicare funds the education and training of medical, nursing and other non-physician health professionals (e.g., physical therapists) through GME (Thies and Harper, 2004). Medicare pays each

[3] Medicare is a public sector insurance fund designed to provide a health care safety net for older Americans.

hospital for DGME according to a formula that reflects Medicare's share of the hospital's patients, the number of residents, and the per-resident cost of DGME. The indirect IME subsidy is a mark-up over the standard fixed amount per inpatient discharge that it pays to hospitals. The formula used to calculate the IME adjustment factor is a function of the hospital's teaching intensity, as measured by the intern-to-resident bed ratio. Wynn *et al.* (2006) estimate that in 2003, DGME and IME amounted to $2.5 billion and $4.9 billion dollars respectively. There is also a limit on the number of residents each hospital could claim for DGME and IME costs. In Maryland and New York, patients covered by private insurance schemes finance GME through state taxes based on an assessment of the number of individuals covered by each payer.

The geographical distribution of the workforce

SFC and NES (2008) identify remote and rural issues as a key concern in Scotland. Simoens and Hurst (2006) and OECD (2008) report that most OECD countries suffer from an unequal geographical distribution of their physician workforce, with rural and deprived urban areas experiencing shortages of physicians, and affluent, metropolitan areas facing surpluses. Countries often have several policies to influence the geographical distribution of doctors, some of which are related to training.

Training initiatives designed to attract doctors to rural and deprived urban areas have been based around the background of the medical student and the content of the medical curriculum. In Australia, there is evidence that selective admission policies of medical schools attract doctors to rural areas. There is also evidence that educational programmes which expose students to practise in rural and deprived urban areas are more likely to attract students to such areas when they graduate. In addition, Australian medical students have at least eight weeks of rural experience in their curriculum and by 2000, 600 scholarships were offered to undergraduate and graduate medical students to work and study in rural areas. In Canada, undergraduate medical students receive training in rural locations and have a rural practice residency or speciality. In Greece, all doctors are required to practise for two years in a rural area after they obtain their medical degree. Since the 1970s, Norway and Sweden have located medical schools in rural areas with the aim of attracting more students from these areas into medical school and of providing more training in rural health. The Physician Shortage Area Program in the United States consists of a selective admission policy (students of rural origin with interest in practising family medicine in rural areas), financial aid, a family medicine programme and rural practice sites. There is some evidence that these training initiatives have been successful in recruiting and retaining doctors in rural areas.

In many countries, scholarships or loans are offered to trainees in return for a commitment to practice in rural and deprived urban areas for a number of years. Medical students who practise in North Norway have been partially exempted from repaying their loan. In Japan, medical students can be exempted from repaying their loan if they work in a public hospital or clinic in a rural area for a certain period of time. In the US, a number of programmes provide scholarships and loan repayment schemes to medical students in exchange for serving in specific areas. The evidence on the success of these return-of-service schemes is mixed (OECD, 2008). Some countries have funded departments of rural health in medical schools in order to expand the rural health component of the medical curriculum. In Australia, the public sector funded the establishment of six university-linked Departments of Rural Health and an Advanced Specialist Training Posts Programme designed to create specialist training posts in major rural centres.

2.3 INTERNATIONAL MIGRATION OF HEALTH PROFESSIONALS

As highlighted in the previous section, while OECD countries have generally attached great importance to domestic education and training, it could hardly balance the supply and demand for workforce completely on its own. Apart from difficulties in exercising health workforce planning per se, a major reason could be the long duration of education for health professionals (around 10 years long for physicians). In addition, exogenous shocks could also lead to unforeseen mismatches between supply and demand, for example "legislative changes with respect to working hours for junior doctors or other health professionals", "a large and sustained rise in public spending on the NHS", "unexpected outflows from the health workforce, including emigration", "exogenous technological innovation" and so on (OECD, 2008, pp. 35). In such contexts, migration emerges as an effective short-term adjustment to health labour markets in many OECD countries with high flexibility but low costs.

This section surveys the existing information on the migration of health professionals. It reviews the patterns and trends of health work migration in the UK, explores factors influencing migration decisions, and finally, describes the regulatory regimes on international recruitment. Again, although our primary focus is the health migration in the UK, regulatory regimes implemented in other major host countries have also been reviewed. A thorough review of numbers, reasons and institutional backgrounds is essential for the subsequent analyses of influences on and impacts of the migration of health professionals.

2.3.1 Patterns and trends of medical migration into the UK

Overseas qualified doctors and nurses have made a significant contribution to health labour markets in the OECD area, particularly in English-speaking countries such as the United States, United Kingdom, Canada and Australia (see Table 2.2) (WHO, 2006). The OECD health policy report (2008) compares graduation and immigration flows of doctors and nurses for 12 OECD countries in the period of 1995-2005. It suggests that whilst the domestic graduation rates generally grow slightly, physician immigration rates rose sharply around the period of 2002-03 or earlier, and remained above graduation rates throughout the period in Australia, Canada, New Zealand, Norway, Switzerland, UK and USA and exceeded graduation rates during the period in Sweden. The case for nurses is the opposite in that domestic graduation rates are much higher than immigration rates in most countries except Denmark, Ireland and New Zealand.

Table 2.2: Doctors and nurses trained abroad working in OECD countries.

OECD country	Doctors trained abroad		Nurses trained abroad	
	Number	% of total	Number	% of total
Australia	11 122	21	NA	NA
Canada	13 620	23	19 061	6
Finland	1 003	9	140	0
France	11 269	6	NA	NA
Germany	17 318	6	26 284	3
Ireland	NA	NA	8 758	14
New Zealand	2 832	34	10 616	21
Portugal	1 258	4	NA	NA
United Kingdom	69 813	33	65 000	10
United States	213 331	27	99 456	5

NA, not applicable.
Source: Working together for health (WHO, 2006), page 98.

In the UK, the latest figure suggests over 91,000 of the 243,910 doctors registered with the General Medical Council (GMC) obtained their medical qualification from overseas countries (Butler, 2008). With the relatively lower medical personnel to population ratio, the British government set out the NHS Plan target of 2000 to increase

7500 consultants, 2000 General Practitioners (GPs) and 20000 nurses by the year of 2004 on the basis of 24401 consultants, 28593 GPs and 335952 nurses in 2000 (DoH, 2002). Besides national workforce strategies such as expansion of medical schools and improving retention, international recruitment has made a major contribution to maintaining adequate medical staffing, particularly in those socially and economically deprived areas (Woodhead *et al.* 2002 cited in Kelly, Morrell, and Sriskandarajah, 2005) and those consultant specialties, for example, that can be hard to fill (Goldacre, Davidson, and Lambert, 2004).

- Doctors

The number of overseas-qualified doctors practising in the UK has grown over the last decade, from 23.7% (19170) in 1993 to 29.4% (32096) in 2003 (Kelly, Morrell, and Sriskandarajah, 2005). The annual data on full registration figures for new doctors from the GMC provides further evidence of this continuing trend (GMC, 2005). Almost two thirds (8102) of new registered doctors obtained qualification abroad in 2004, of which doctors from the EEA account for 30%. The Indian subcontinent and the Middle East are traditional suppliers of doctors to the NHS. Although the ethical Code of Practice (DoH, 2004) has called for NHS employers to only target international recruitments at countries with medical staff surpluses, doctors from developing countries like South Africa have been recruited continually (Buchan and Maynard, 2006).

Foreign medical graduates contribute less to consultant level than junior and intermediate level posts as a result of the pyramidal structure of the health workforce in the UK (Dobson, 2004). Of the medical and dental staff in the hospital and community health services (HCHS) of the NHS in England in 2006, foreign graduates constitute 28% of consultants, 74% of staff grades and 40% of doctors in training and equivalents[4]. Nevertheless, Specialist medical practices in the NHS have progressively and significantly recruited overseas-trained consultants in the recent years, making up from 15% before 1992 to 24% in 1992-2001, particularly in specialties where posts have been hard to fill with the domestically-trained workforce (Goldacre, Davidson, and Lambert, 2004). Indeed, consultants trained abroad are over-represented in the top ten NHS specialities, accounting for more than one third of all doctors employed (Kelly, Morrell, and Sriskandarajah, 2005).

- Nurses

Immigrant nurses are estimated to account for around 10% (65000) of the total registrants with the Nursing and Midwifery Council (NMC), and 44% (15152) of the initial registration in 2003/4 (Kelly, Morrell, and Sriskandarajah, 2005). Despite these lower proportions compared with doctors' in relative terms, their significantly high numbers suggest the UK is a much larger market for nurses and midwives. In addition, non-EEA countries are major destinations of nursing recruitment, regardless of the mutual recognition of qualifications between the UK and the EEA (Kelly, Morrell, and Sriskandarajah, 2005). Nurses from non-EEA countries represent more than 90% of foreign admissions, and the main non-EEA sources are India, the Philippines, South Africa and Australia. During the period of 1998 to 2005, India and Philippines have surpassed the traditional donor countries - the more developed commonwealth countries of Australia, New Zealand and South Africa, and contributed more than half of all foreign registrants. Among the top ten donor countries, five of them are identified as developing countries where NHS recruitment is proscribed by the Department of Health (NHS Employers,

[4] The Information Centre for health and social care: http://www.ic.nhs.uk/statistics-and-data-collections/workforce

2005). Though, the year of 2005 has seen a fall in admissions from four of them such as South Africa, Nigeria, Zimbabwe and Ghana, with the exception of Pakistan.

- Dentists

In dentistry, 23% (7497) of the total registers in 2005 with the General Dental Council (GDC) obtained their qualifications overseas, among which EEA qualified dentists represent more than half (53%). Of 2,257 dentists added to the register in the same year, half (1136) of them were EEA qualified and only 34% (776) were "home trained". In other words, countries within the EEA, particularly Poland, Spain and Germany, are the main donor countries of foreign dentists working in the UK, which is clearly distinguishable from doctors and nurses as above highlighted.

In particular, the much greater proportion of migrant health professionals in the annual registration than in the overall workforce, on the one hand, suggests the increasing significance of international recruitment in staffing of UK medicine. On the other hand, many health professionals migrated to the UK on a temporary, contract basis rather than a permanent basis. Indeed, the NHS has a long history of offering salaried training posts and supernumerary posts in public hospitals to foreign professionals for limited periods of time through training and educational programs, which has succeeded in overcoming staffing crisis in short term. South Africa, for example, signed an agreement with the UK in 2003 that the health professionals will return home where their posts are kept open after the exchange period (WHO, 2006). According to the nursing registration data, for example, more than half of non-EU nurses who initial registered in 1995 did not re-register in 1998 as required if they wish to continue practising in the UK (Buchan and O'May, 1999).

2.3.2 Factors influencing migration decisions

The high demand for health professionals and active recruitment by host countries has encouraged and facilitated the migrations in the health sector. Apart from external or exogenous factors, the migration could also simply be a result of professionals seeking employment opportunities and job security in the dynamic globalized health labour markets. Existing research lists factors that motivate only some professionals in the donor country to migrate to a particular host country, for example, differences between two countries in remunerations, professional developments, working environments and so on (Bach, 2003).

Similar to migrations in other sectors, the possibility to enhance earnings reinforces the attractiveness of medical migration. Comparisons of wages between main donor countries and host countries made by Vujicic *et al.* (2004) suggest significant differentials (2-25 times for doctors and 2-29 times for nurses) even after cost-of-living adjustment. However, it is also interesting that South African professionals earn 5-6 times more than Ghanaians, but show almost the same intention to migrate. This suggests that changes in the wage differentials, alone, would have little impact on the supply of migrants (Vujicic *et al.*, 2004). The high supply from donor countries may be attributed to better training opportunities in developed countries. A second possible reason is that work experiences in South Africa can increase the likelihood of being offered employment in developed countries, making migration costs from South Africa much lower than from Ghana.

Furthermore, a major stimulus for migration for highly skilled workers could come from continuous professional and personal development. It is a widespread belief that a period of training or working experience in the NHS can enhance the career prospects and provide access to better working opportunities. A survey of non-European doctors working in the UK in 2006 reported that over three-quarters (76.7%) had chosen the UK mainly for 'training', only 7.2% for better pay and 7.1% for better work environment (George *et al.*, 2007). Data on HCHS staff in 2006[5] well confirms the importance of professional development and training on medical migration decision: over half (53%) of the overseas-trained doctors migrated for training grade posts, compared with 12% working in staff grade and 26% as consultants. Enhanced skills and experience are important features that underpin international healthcare mobility.

Poor working environments may also push professionals to seek employment abroad. The influences in this context involve the lack of occupational protection, the AIDS epidemic and its resultant workload increase, the inadequate resources and facilities, the inefficient management of health services, the low social prestige for health professionals (especially nurses and community health workers) and the threat of violence (Alkir and Chen, 2004).

Other factors that are found to be important in the migration decision include differential tax regimes (Barrett, 2001 cited in Bach, 2003), language traditions with training, the existence of migrant professional communities from the donor country (Commonwealth, 2001 cited in Dovlo and Martineau, 2004) and so on.

While the push and pull factors documented above can obviously affect the migration decisions of health professionals, the institutional regulation can also be an important influence. Indeed, due to its dual – social and economic – function, health care is typically supported by the public sector and highly regulated domestically. These regulations may act as a powerful barrier to international mobility of health professionals (Manning and Sidorenko, 2007) and will be discussed in details in what follows.

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[5] The Information Centre for health and social care: http://www.ic.nhs.uk/statistics-and-data-collections/workforce.

2.3.3 Regulatory regimes in migration of health professionals

As health professionals from developing countries make significant and escalating contribution to the health workforce in industrialized countries, there is increased awareness of the importance of regulating and monitoring international recruitments. In addition to generic regulations (e.g. a wide variety of national administrative practices for controlling the inflow of non-nationals and the outflow of nationals), sector-specific regulations of international migration have been adopted to maintain high quality of health care delivered in host countries, and minimise the brain drain and losses of public health sector investment in developing countries (Manning and Sidorenko, 2007). In what follows, we describe regulatory policies on the health professional migration undertaken in main host countries in terms of three key features: migration policies, registration and relicensing regimes, and ethical management of international recruitment.

Migration policies

Host countries adopt different migration policies according to the demand for health workforce in each country.

In the United State, the Federal Government estimated that 35 million people live in areas without doctors, and 16,000 doctors are needed to fill this gap (Cichowski, 2010). But an independent review (Chou, 2006) shows that the Government report was rather conservative, and that at least 200,000 doctors will be needed by 2020 due to increasing population growth and aging populations. H-1B visas are thus introduced to foreign nationals with technical skills in specialty occupations. Having gained popularity in the information technology sector, there is now an increasing trend for hospitals to act as sponsoring employers in recruiting International Medical Graduates (IMGs) with no obligation to return home to fill the shortage of medical personnel. More importantly, H-1B visa holders are also eligible to apply for permanent residency to settle in the US after fulfilling residency requirements, and this is another highlight as it offers many people the chance to pursue their "American dreams" (Mullan, 2005).

In Australia, migration policies are also simpler for health professionals. Currently, visa class 457 and 422 are available to non-Australian citizens in the employment of medical professionals. Since April 2005, visa class 457 was created for foreign medical practitioners to apply in the form of Temporary Business Long Stay Visa. Alternatively, foreign doctors may apply for visa class 422 – Medical Practitioner Visa, which allows health professionals to gain permission to work in rural Australian communities or for local councils through a sponsoring scheme as an individual medical practitioner in a solely-run practice without a direct employer. All applicants applying for these visas of temporary entry nature must have appropriate recognised medical qualifications as well as in the possession of conditional registration to practice medicine in Australia. Once these applicants gain full medical registration status after a few years of practice and passed assessments and examinations set by the medical licensing authority in their location, they may be able to apply for permanent residency to stay in Australia on a permanent basis under any category of the point-based General Skilled Migration Program; after satisfying further criteria under permanent residency status, applicants may then be eligible to apply for Australian citizenship (Carver, 2008).

In European countries such as the United Kingdom, Belgium, Ireland, Denmark, the Netherlands or Spain, health professionals are put on shortage lists with no need for work permits (OECD, 2008), although the situation for the UK has recently changed. The recruitment of foreign doctors into the health service sector had been a large concern for both the general public as well as the sector itself. The debate is essentially centred on two opposing arguments for the scheme. On one hand, the government draws up plans to improve health services by increasing the number of doctors and specialists. According to estimates however, this cannot be achieved without a corresponding inflow of extra doctors from overseas. On the other hand, there are also major concerns that a large influx of migrant graduates will potentially displace UK medical graduates from obtaining training opportunities (Grantham, 2008). In 2007, out of the 23,247 training posts available in the NHS which attracted 32,649 medical students to apply, 10,000 of the students were migrants (Grantham, 2008). To secure the training and employment opportunities for an increased number of UK medical graduates, the Home Office announced changes of immigration rules affecting doctors, dentists and band 5&6 nurses recently (NHS Employers, 2007).

The category in the immigration rules for postgraduate doctors and dentists, which enabled foreign graduate to train in Foundation Programmes, Senior House Officer and equivalent grades and in Specialist Registrar and equivalents grades for many years, was announced to be changed (DoH, 2006). Foreign graduates who take up training posts are considered as in employment rather than in training. The majority of non-EEA candidates for posts will require a work permit, which means the unavailability of EEA nationals to fill the post should be confirmed before the approval for international recruitment; while EEA nationals, who have automatic right to work in the UK, only need to register with Workers Registration Scheme. Migrants with valid leave as a Postgraduate Doctor or Dentist will continue on the current conditions, and so will doctors with insufficient leave to enter/remain to complete a programme because the guidance will continue to be held in abeyance due to the practical difficulties in making changes at the current stage (NHS Employers, 2007). The category of Postgraduate Doctors and Dentists will still exist, but only to enable those UK graduate to take their Foundation Programme. As to nursing recruitment, band 5 and 6 nurses have been removed from the shortage occupation list since 14 August 2006. Therefore, an employer can no longer apply for a work permit for band 5 and 6 nurses without proving they could not fill their vacancy with resident worker. Nurses at band 7 or 8, or in particular specialities are still recognised as the “shortage occupations”.

The NHS and the Department of Health have been criticised for the poor planning on these new policies. Since then, the number of IMGs and foreign doctors applying to work in the UK has dropped significantly and surveys revealed that the number of IMGs wishing to stay in the UK to work fell significantly. Meanwhile, some hospitals complained that they had vacancies that cannot be filled, and there were reported shortages of doctors in some areas in England and Wales throughout 2008. Perhaps the cause of this result was foreign doctors and IMGs being put off by the new immigration and recruitment policies, or confused by reports that there were as many as 10,000 doctors unemployed in the UK in 2007. The Department of Health and the NHS then reassured that opportunities are still open to qualified overseas doctors and IMGs through four routes: (i) international development exchange programmes; (ii) reciprocal training schemes; (iii) short-term clinical skills training contracts arranged by Royal Colleges; (iv) positions that cannot be filled by suitable UK or EEA candidates. All four routes were incorporated into the later point-based migration management system and operated under Tier 5 of that system, which allow successful applicants to work for up to two years in the UK on sponsorships from a specific employer. Since the UK considers itself as a non-immigrant country, it is very difficult for foreign nationals to settle to be naturalised as British citizens, even if they are highly educated medical professional with specialised skills (Grantham, 2008).

Registration and relicensing regimes

As a key feature of the health professional migration, migrant health professionals need to successfully pass language tests and professional licensing examination to be registered as an eligible healthcare provider. The UK, Finland and Ireland require applicants to attend a period of adaptation or initial supervision before registration. Some host countries shorten the procedures by introducing temporary or conditional registration for certain health professionals, for example, the Netherlands issues registration for individuals with near-equivalent skills, Australia for health professionals migrating on sponsoring schemes, or New Zealand for individuals continuously working in a comparable health system for at least three years; while some other countries set out exceptional high registration requirement for migrant health professionals, for example, national postgraduate qualifications in Canada, satisfactorily completing internship and postgraduate residency training in the USA, or obtaining citizenship in Italy, Finland, Greece, Turkey and Luxembourg (OECD, 2008).

In the UK, more specifically, NHS Employers have provided guidance on the registration of international doctors, dentists, and nurses (NHS Employers, 2005).

- Doctors

All doctors, including GPs and consultants, must register with the GMC before they can take up a post in the UK. EEA doctors are eligible for immediate full registration with GMC and even specialist registration as long as their specialist qualification recognised by the European Medical Directive. Alternatively, non-EEA doctors and EEA doctors in particular specialities need to successfully complete the following examinations to be eligible for registration: 1) passing the International English Language Testing System (IELTS) to the required standard (e.g. Overall 7, Speaking 7, Listening 6, Academic reading 6 and Academic writing 6); and 2) taking the Professional and Linguistic Assessment Board (PLAB) to demonstrate the GMC whether they have the basic medical competence and communication skills to practise medicine in the UK. To qualify for the General Practice Registration of the GMC, EEA GPs needs to submit evidence of their qualification in general practice to the GMC, while non-EEA doctors and EEA doctors in particular specialities need to pass an assessment by the Postgraduate Medical Education and Training Board (PMETB). Normally the PMETB will recommend at least three to six months' induction into NHS general practice as a GP Registrar with formal assessment and those who satisfy PMETB will obtain the Statement of Eligibility for Registration (formally the Certificate of Equivalent Experience). At the consultant level, Specialist Register of the GMC is required to practice in the UK. The non-EEA doctors and EEA doctors in particular specialities need to be assessed by PMETB to be eligible for registration.

- Dentists

Similar to the registration requirements for doctor category, EEA-qualified dentists have automatic registration with the GDC, while non-EEA dentists need to pass IELTS (a minimum score of 6.5 in each section and an overall average of 7) and the International Qualifying Exam to be admitted by GDC Registration.

- Nurses

The NMC is the regulatory body for nurses and midwives in the UK, which is responsible to issue registration enabling its holder to practise. Nurses with equivalent qualifications from EEA have automatic registration with the NMC, while non-EEA nurses are required to pass the IELTS and undertake all or part of the Overseas Nurses Programme (ONP) to gain registration. The score standard of IELTS has been changed since 1st February 2007: a minimum score of 7 in each section and an overall average of 7, compared with a minimum score of 5.5 in the listening and reading sections, 6 in the writing and speaking sections and an overall average of 6.5. In the ONP, nurses must complete a compulsory 20-day period of protected learning and a three-to-six-month period of supervised practice if needed.

The US, as one of the most developed countries in the world, has some of the strictest and comprehensive rules for granting license to practice medicine to medical graduates of foreign nationals (Hallock, 2003). First of all, IMGs seeking to take up graduate medical training must have their qualifications evaluated by the Educational Commission for Foreign Medical Graduates; if IMGs attended medical schools outside the US or Canada, the programs they studied must be officially recognised and medical schools they attended must be accredited by the Accreditation Council for Graduate Medical Education (ACGME). The ACGME's certification involves education requirements and comprehensive examinations, where IMGs must first satisfy the requirement of completion of medical education, then pass Step 1 and 2 of the United States Medical Licensing Examination (USMLE) as well as a test in English language proficiency. On the practical side, an assessment in clinical skills is also in place in Step 3 of the USMLE to test the practical ability and skills of IMGs. Since each individual state has a medical licensing authority, and other US (overseas) territories have their own licensing authorities as well, the rules and regulations for granting license to practice medicine are different in different areas as each licensing authority has its own jurisdictions. Also the procession of license issued by one licensing authority does not give the automatic right to obtain licences of other licensing authorities. Although licensure rules vary in different areas, all licensing authorities have three core requirements in common for licensure: (i) examination requirement, that applicants must pass appropriate examinations; (ii) education requirement, that applicants must complete and pass recognised medical trainings at graduate level; (iii) practical skills requirement, that applicants must pass assessments in clinical skills.

The Australian Government has many approaches in place aiming for the integration of IMGs with their medical education environment and practice experience (Carver, 2008). Similar to the United States, there is not a single licensing authority to issue license to practice medicine in Australia. Having realised the inefficiency and inconvenience of operating different systems across the country, an agreement was reached in 2006 by the Council of Australian Governments to establish a unified national system in assessing and evaluating IMGs with nationally consistent processes. According to this national system, IMGs are to be assessed before they take up employment using standardised examinations; competence of the medical position IMGs apply for are also assessed before limited registration are awarded by the medical licensing authority, which may involve a clinical interview. After the employment is approved by the Australian Medical Council, IMGs must go through orientations to learn about the Australian health care system, as well as different cultural issues to minimise any communication problems that may arise due to Australia's multi-culture background. Continuous on-the-job supervisions and reporting are also in place to ensure the standard and quality of medical practice; and in order to re-register with the licensing authority on a periodical basis to renew the right to practice medicine, IMGs must enrol themselves to compulsory continuing professional development programs to keep up with their knowledge base. Apart from theoretical knowledge, assessments are also carried out at workplace for evaluating practical skills. Only after passing all these processes and subject to further licensing assessment would IMGs be eligible for full medical registration status, and once fully qualified, continuous of consistent assessments in specific medical areas are in place set by specialist colleges should IMGs decide to become specialists.

Ethical management of international recruitment

The United Kingdom has taken the lead in establishing ethical codes for international recruitment of health professionals (OECD, 2008). The Code of Practice for NHS employers involved in the international medical recruitment was first published in October 2001 and then revised in December 2004. The Scottish Executive has introduced a similar code in March 2006. The target of the Code is not only to promote high standards in the recruitment and employment of health professionals from overseas, but also "to mitigate the adverse effects of migration of health personnel" (DoH, 2004, pp. 3). Based on the ethical principles, the Department of Health and the Department for International Development, according to economic and medical staffing status, have produced a list of developing countries that should not be actively recruited from, unless an explicit government-to-government agreement with the UK have been reached to support recruitment. NHS employers are expected to use this government-to-government agreement to achieve ethical recruitment. For example, registered mental health nurses are authorised to recruit from Ghana for up to a three-year period of employment. Similarly, dentists from Poland, and health professionals, particularly nurses, from Philippines, China and India have been agreed for direct recruitment. These established country-to-country campaigns offer migrant health professionals with professional development and training opportunities, and consequently benefit donor countries through the exchange of knowledge and skills.

The Australian Government followed and introduced the Commonwealth of Nations Code of Practice for the International Recruitment of Health Workers to rule out direct recruitment from developing countries (Lennon, 2005). Some other host countries have also used bilateral agreements for international recruitment, for instance, Switzerland, Canada, France, Germany and Italy, but far less intensively (OECD, 2008).

2.4 CONCLUSION

International recruitment provides governments with a flexible and low-cost response to shortages in the presence of global crisis in the health workforce and makes an escalating contribution to health care labour markets in industrialized countries. This chapter provides the institutional and policy background for the health professional migration, which however, cannot be viewed alone without mentioning the efforts governments devote to long-term policies of domestic training.

We first described the structure and finance of training for health professionals across countries. There is variation in the nature of funding the provision of health care across countries, which gives rise to variation in the structure and finance of training for health professionals. Firstly, it is not uncommon to use quantity rationing to limit access to professional training. However there are several countries where there is rationing by price such as India, Poland and Ireland. There is some evidence of a relationship between quantity rationing and the density of health professionals. Second, there is some element of private sector funding of undergraduate health training in many countries, while the Britain's systems is unique in being entirely funded by the public sector. Thirdly, there is significant variation in the funding of the additional costs of teaching undergraduate courses. In Germany, this reflects the funding of the overall health system where health care is funded by insurance funds and there is a strict separation of clinical and academic funding. In Australia, ACT is paid to health care providers by medical schools. In Ireland, there is no explicit ACT payment. Some countries provide ACT for nurses, others do not. Finally, postgraduate medical education is funded in several different ways. In Germany and the US, the costs are borne partly by trainees who accept a relatively low training wage. In Canada, funding is provided by the public sector. In Ireland and Australia, where there is no hypothecated postgraduate training funding, there are concerns around the quantity and quality of postgraduate training. Despite these variations in the structure and funding arrangement of domestic education, countries are generally suffering from the imbalance between the supply and demand for workforce, largely because of the long duration of education which hardly responds to the workforce mismatch in time and also the difficulties in workforce planning.

We then review the patterns and trends of health professional migration into the UK, explore factors influencing migration decisions, and describe regulatory policies related to migration in the health sector that are undertaken in major host countries. In recent years, the UK has seen a growing inflow of doctors, dentists and nurses, with most of doctors and nurses from outside the EEA areas, while dentists mainly from within the EEA. The significant remuneration differences between donor and host countries, working environment, and most importantly, professional developments are reported as major reasons for these movements. Besides, the regulation regimes with respect to migration of health professionals could also be an important influence, including migration policies, registration and relicensing regimes, and ethical management of international recruitment. OECD countries have in general adopted selective migration policies to facilitate health professionals, for example, the US introduced H1-B visas specific for health professionals, Australia and New Zealand offer extra points in permanent migration programmes, and European countries put health professions on shortage lists with no requirement for work permits. In the UK, however, these policies changed after 2007, with postgraduate doctors, dentists and band 5&6 nurses removed from the shortage list to secure training and employment opportunities for the increased number of domestic graduates. However, while it seems relatively easier for health professionals to move into a new country compared with other professions, this is not the case for them to practise in the new country. Host countries generally set out restrictive requirements of relicensing and registration to control entry and guarantee the practice standards of migrant health professionals. While some countries shorten the procedures for a group of professionals who are considered to be "qualified", some other countries, with the highest popularity in the global health labour markets, increase requirements to limit the entry. Finally, the negative impact of the migration on donor countries has also drawn considerable attention, and some host countries have introduced ethical codes of practice for the international recruitment to avoid recruitment from developing countries unless a government-to-government agreement is achieved.

These features are specifically related to the health sector and should be taken into account in order to gain a comprehensive understanding of health professionals' migration and return decisions. In the next chapter, we shall incorporate these features into a formal model framework to investigate the individual migration and permanent residence decision of health professionals.

APPENDIX TO CHAPTER 2

Table A2.1: Structure of training for physicians.

	Basic (undergraduate) Education	**(Post)graduate Education / Specialization**	
Australia	Undergraduate-entry program: 5-6 years; Graduate-entry program: 4 years. (theoretical teaching and early clinical exposure)	Internship in hospitals: at least 1 year - Full registration (3 core terms of supervised practice +formal educational opportunities)	
		Resident Medical Officers in hospitals: 2 years - Provider Number Issued	
		General Practitioner (Fellow of the RACGP)	Specialist (Fellow of the RACS)
Canada	Graduate/Second entry program: 3-4 years (1/2 basic science, 1/2 clinical clerkship)	Residency training: 2-6 years Year 1: MCCQE - Licentiate of the Medical Council of Canada	
		Family medicine: 2-3 years Full licensure accredited by CFPC	Specialty: 4-6 years. Full licensure accredited by RCPSC
France	Undergraduate-entry program: 6 years (1/2 basic science, 1/2 Extern in hospitals) Year 1: internal ranking examination for *numerous clausus* Final year: National ranking exam to determine specialties	Residency training: 2-6 years	
Germany	Undergraduate-entry program: 6 years (2-year preclinical classes, 3-year clinical classes, one-year internship in hospitals) Non-academic - federal medical exam licensing degree Academic - dissertation Graduation - Full Registration	Practice-based specialization	
		Non-academic: 2-3 years	Academic: 4-6 years General practitioner: 4 years
India	MBBS Programme: 5½ years (4½-year didactic lectures and clinical clerkship or rotation, 1-year intern or house surgeon in hospitals (CRRI)) Final MBBS examination - Provisional registration CRRI complete - Permanent registration and Medical degree	Postgraduate Degree or Diploma: 2-3 years Sub-specialization: 3 years	
Ireland	Undergraduate-entry program: 6 years; Graduate-entry program: 4-5 years. (last two years in the affiliated teaching hospitals)	Internship: 1 year - Full registration	

Table A2.1: Structure of training for physicians (continued).

<table>
<tr><th></th><th>Basic (undergraduate) Education</th><th colspan="2">(Post)graduate Education / Specialization</th></tr>
<tr><td rowspan="2">Italy</td><td rowspan="2">Undergraduate programme: 6 years/12 semesters
(1/2 pre-clinical courses,
1/2 rotations at different hospital departments
and/or some clinical theoretical courses)
Thesis or dissertation - Academic degree</td><td colspan="2">Not-paid internship: 3 months
State (license) examination - Registration as GPs
Examination - School of Medical Specialisation</td></tr>
<tr><td colspan="2">Specialisation: 4-6 years
(supervised training and theoretical courses)</td></tr>
<tr><td>Japan</td><td>Undergraduate-entry programme: 6 years
Last two years: clinical training in University Hospitals
National Medical License examination - Full registration</td><td colspan="2"></td></tr>
<tr><td>Holland</td><td>Undergraduate-entry program: 6-7 years
(4-year preclinical training, 2-year clinical training) or
(3-year preclinical training, 3-years clinical training)</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Norway</td><td rowspan="2">Undergraduate programme: 6-6½ years
Special research pathways: 7 years</td><td colspan="2">Internship in rural areas ≥ 18 months - a medical license
(6 months internal medicine ward, 6 months surgical ward,
6 months general practice)</td></tr>
<tr><td colspan="2">Specialist training ≥ 5 years (9 years in average)</td></tr>
<tr><td rowspan="2">Philippines</td><td rowspan="2">Graduate-entry programme: 4 years
(Year 1&2: basic science,
Year 2&3: clinical science, Year 4: rotation)</td><td colspan="2">Internship in an accredited hospitals
Medical licensure examinations</td></tr>
<tr><td>Graduate programs in medicine: 1-5 years</td><td>Medical specialization: 3-6 years</td></tr>
<tr><td rowspan="2">Poland</td><td rowspan="2">Undergraduate programme: 6 years</td><td colspan="2">Internship: 13 months
A national examination for licensing</td></tr>
<tr><td colspan="2">Specialization: 3-7 years</td></tr>
<tr><td rowspan="3">United Kingdom</td><td rowspan="3">Undergraduate-entry programme: 5-6 years
Graduate entry programme
(2-year preclinical training,
3-year clinical training at a teaching hospital)</td><td colspan="2">2-year Foundation Programme: rotations
F1 - full registration with GMC</td></tr>
<tr><td colspan="2">Specialty Training - Certificate of Completion of Training (CCT)</td></tr>
<tr><td>General Practitioner
GP Register - 3 years</td><td>Consultant
Specialist Register - 6 years</td></tr>
<tr><td rowspan="2">United States</td><td rowspan="2">Second-entry programme: 4 years
Undergraduate-entry programme: 7 years
(1/2 pre-clinical training, 1/2 clinical rotations)</td><td colspan="2">(Traditional rotating internship: 1 year)
Specialty training program/Residency: 3-7 years</td></tr>
<tr><td colspan="2">Fellowship in highly specialized fields: 1-3 years
Fellow - Board Eligible or Board Certified</td></tr>
</table>

CHAPTER 3
THE SELF-SELECTION OF MIGRANT HEALTH PROFESSIONALS

3.1 INTRODUCTION

Given the strong sector-specific characteristics of the migration of health professionals discussed in the previous background chapter, it is necessary to investigate the individual migration and permanent residence decisions of health professionals in context. This chapter extends the self-selection model by Borjas and Bratsberg (1996) to explicitly account for sector-specific factors such as the motivation of career development and various regulatory regimes.

International migration becomes a basic structural feature of nearly all industrialized countries, and its emergence has been explained at a variety of perspectives, levels and assumptions. Neoclassical economics (Sjaastad, 1962; Todaro, 1969; Todaro and Mamszko, 1987; Borjas, 1987) views migration as an individual decision for income maximization, while the "new economics of migration" (Stark and Bloom, 1985) conceives it as a household decision to minimize risks. Instead of focusing on such micro-level decision processes, dual labour market theory (Piore, 1979) and world system theory (Portes and Walton, 1981; Petras, 1981; Castells, 1989; Sassen, 1988; Morawska, 1990) link immigration to the structural requirements of national and international economies, respectively. Nevertheless, these theories are not inherently compatible when understanding causal processes of immigration because it might operate on multiple levels simultaneously. In fact, the complicated and multifaceted nature of contemporary immigration calls for the incorporation of different levels of analysis (Massey *et al.*, 1993).

This chapter analyses the migration decisions of health professionals in the light of neoclassical microeconomic model. In neoclassical economics, individual rational actors choose whether or not to migrate through maximizing their expected discounted net earnings over some time horizon, net of migration costs. The expected income depends on the actual (or average) earnings and the probability of employment. Assume that individuals are risk neutral and their other characteristics than skills are the same. Thus, individuals should consider the following function when deciding whether to migrate at *t*=0:

$$Y^e(0) = \int_0^n \left[P_h\big(U_h(t)\big)Y_h(t) - P_d\big(U_d(t)\big)Y_d(t)\right]e^{-rt}dt - C_m, \qquad (3.1)$$

where $Y^e(0)$ is the discounted present value of the expected return of migration at time 0; *t* is time; P_h and P_d are the probabilities of employment in the host country and donor country; $U_h(t)$ and $U_d(t)$ are the unemployment rate in period *t* in the host country and donor country; $Y_h(t)$ and $Y_d(t)$ are net expected real income in period *t* if employed in the host country and donor country based on, say, the average real income of previous periods; *r* is the discount factor; C_m is the cost of migration and relocation in the host country; and *n* is the individual's time horizon. A rational individual migrates if $Y^e(0) > 0$, and stays if $Y^e(0) < 0$.

Based on the same behavioural hypothesis of income maximization and the theoretical formulation by Roy (1951), Borjas (1987) assumes that the log earnings which potential migrants face in the donor country and host country have a joint normal distribution, and systematically analyses the impact of the selection process on the scale, direction and skill composition of migration flows. The Borjas model offers a new rigorous framework to analyse the skill composition of migration flows, which is particularly crucial for evaluating the economic consequences of migration. It is the skill-price differentials between two countries that determine the skill composition. *Positive selection* occurs when the host country offering higher rewards to skills draws migrants from the upper tail of the income distribution; *Negative selection* occurs when the host country offering a smaller payoff to skills attracts individuals with below-average skills to migrate; and *Refugee sorting* occurs when immigrants do badly in the donor country but well in the host country, where the skill components of earnings in the donor country are not closely or even negatively correlated with those in the host country.

Borjas and Bratsberg (1996) extend this self-selection model to the return migration decisions of foreign-born persons, in which the possibility of Refugee Sorting is excluded by assuming a perfect correlation between the skill components of earnings in the two countries. In this model, the presence of numerous return migrants may be attributed to either erroneous information about economic opportunities in the host country or improved economic options in the donor country after a practice experience abroad. The return migration is predicted to intensify the original selection process of immigrant flows. That is to say, permanent immigrants are the “best of the best” in the case of positive selection, and the “worst of the worst” otherwise.

In the context of migration, the economic gain needs to be weighed against the costs corresponding to migration process. Migration costs are an important factor in the analysis of migration decisions and generally involve psychological, out-of-pocket, and opportunity costs. The psychological costs include the disutility associated with leaving behind family ties and social networks. The out-of-pocket costs include commuting expenses, fees, and household goods setting up for a new home. The opportunity costs involve the foregone wages while travelling, searching for, and learning a new job and are affected by immigrants' skill level and unemployment rate in donor and host countries (Sjaastad, 1962). However, these models in general base discussions on the assumption that costs of migration remain constant in the population, which in turn limits the applicability of these models in empirical analysis. In fact, it has been argued that economic migrants are presumably favourably "self-selected" for a labour market success, such that a higher variance of earnings in the donor country does not necessarily yield negative selectivity but rather only less favourable positive selectivity (Chiswick, 1999). Brücker and Trübswetter (2004) draw a similar conclusion based on an extended version of Roy's model assuming skills and moving costs are negatively correlated.

Besides factors that motivate general migration (e.g. wage difference, valuation of skills and migration costs) that have been extensively discussed in the neoclassical microeconomic model, the stringent regulatory regime can be a very important determinant to medical migration and return. Foreign professionals are normally severely limited in entering the health sector due to the social dimension of health care. It has been asserted that the importance of institutions in generating and sustaining international migration needs to be considered explicitly in the highly regulated health sector (Bach 2003; Commander, Kangasniemi and Winters 2002; Manning and Sidorenko, 2007). In the case of UK, the regulatory regimes that need to be considered involve the country-to-country campaign, relicensing regime and work permits.

The country-to-country campaigns, advocated in the Code of Practice, have established “critical paths” of medical migration, for example, for Filipino, Indian nurses and Polish dentists. Carrington *et al.* (1996) state that migration tends to develop momentum, even as wage differentials narrow, because the established network of previous migrants can lower migration costs. And yet, the influence of social networks has been rarely acknowledged in the analysis of medical migration (Bach, 2003).

The existing studies of occupational licensing have emphasized the important effect of licensing on the supply of both the native and migrant labour, particularly in the health sector with stringent regulation (Kleiner 2000; 2003). The mobility of professionals is significantly reduced in different licensed professions because of the high costs of meeting the entrance requirement. For example, Boulier (1980 cited in Kleiner, 2003) examined dentists, and Kleiner *et al.* (1982 cited in Kleiner, 2003) covered 14 licensed occupations, including six health professions. Kleiner (2000), thus, affirms that political institutions could be used to control the initial entry and in-migration in the state-regulated occupations. However, White (1980 cited in Kleiner, 2003) finds little impact on employment levels of registered nurses. The small impact of regulation has been found in other low wage and low education occupations such as cosmetologist and barbers (Thornton and Weintraub, 1979 cited in Kleiner, 2000). One possible reason is the relatively looser regulation for nurses due to their less established role in professional organizations compared with doctors.

Nevertheless, although there is evidence that the quality of individual professionals, such as dentists and optometrists, can be enhanced as a consequence of restricting supply of lower skilled applicants (Holen, 1968; Carroll and Gaston, 1981 both cited in Kleiner, 2003), recent analyses suggest an ambiguous effect on quality of outcome due to the countervailing force of prices. The increased price and wages caused by licensing regulation tend to reduce the quantity of healthcare demanded, and therefore reduce the quality of healthcare received (Kleiner, 2000). Holen (1978 cited in Kleiner, 2003) finds a positive effect of dentists licensing on the quality of care, while Kleiner and Kudrle (2000) discover that tougher licensing in terms of either licensing statutes or pass rates does not improve outcome of dental care. Furthermore, Kugler and Sauer (2005) study a model of optimal license acquisition in which relicensing costs vary among individuals of different skill levels, and prove both theoretically and empirically that stricter relicensing requirements could lower migrant physician quality.

Similarly, the work permit requirements may restrain the mobility of health professionals as well. Work permits place great demand on the skills and specialty of foreign applicants to secure EEA nationals. In addition, employers may be reluctant to recruit internationally because of the time consuming procedure and extra costs imposed by additional advertising and administrative expenses.

In a word, while there exists extensive literature on Labour Economics examining the migration decisions of general workers, the skilled migration of health professionals exhibiting strong sectoral properties requires an accurate and comprehensive analysis (Commander, Kangasniemi and Winters, 2002). The existing health policy literature has well documented the push and pull factors that influence the migration decisions of health professionals, but rarely addressed the extent to which these factors affect the decisions (Vujicic *et al.*, 2004). This chapter contributes to the literature by incorporating these sector-specific features into the self-selection model by Borjas and Bratsberg (1996) and examining how these factors influence the direction, scale and skill composition of the migration flow. A comprehensive understanding of health professionals' migration and return decisions is essential to develop policies regulating and controlling migration in- and outflows.

The remainder of this chapter is organised as follows. The following section lays out the mechanics of the extended model which considers the investment motivation of professional development and training, and allows for a correlation between labour market abilities and moving costs. The penultimate section explores potential influences on the scale and skill composition of (permanent) migrant health professionals, particularly of institution variables; and the final section concludes.

3.2 THE EXTENDED MODEL

To examine the effects of remuneration, professional development opportunities, and regulation regimes on the migration and return decisions of health professionals, we use a variant of the model by Borjas and Bratsberg (1996). For a better understanding of the migration decision in the neoclassical economics scheme, it is instructive to initially set forth the following important assumptions.

1. The earnings in both countries are time predictable;
2. An individual has the same time profile of working life;
3. The probability of employment is not time-variable.

Given these assumptions, we can consider a two-country, one-period and static model where health professionals of the donor country (country 0) decide whether to migrate to a foreign country (country 1) temporarily or permanently.

We assume that the relative skill endowments of health professionals in the donor country follow a normal distribution $v \sim N(0, \sigma_v^2)$, which can be known to the individual and transferable across countries. The log earning distributions facing a professional in the donor and host countries are determined as follows:

$$w_0 = u_0 + \eta v \quad \text{and} \quad w_1 = u_1 + v, \tag{3.2}$$

where u_0 is the mean log income in the donor country, and u_1 is the mean income in the host country for this particular population. The variable η measures the rate of return to skills in the donor country relative to the host country: the higher the return on skills, the greater the income inequality.

Besides the pursuit of better pay, health professionals may seek a period of employment abroad in the belief that it will aid professional development and enhance earnings both in the donor and host countries. For this investment motivation of professional development and training opportunities, we assume that an immigrant's professional skills will enhance by k after spending the fraction π of his whole working life in the host country. We assume that π is endogenous to migrant individuals. It depends on the demand for health workforce and relevant regulatory policies adopted in different host countries. The return on the foreign practice experience may vary in individual cases as different professionals may give different level of efforts and commitments and demonstrate different ability of adapting to an alien work environment. Thus, the distribution of the random variable k for professionals in the donor country is given by:

$$k = k_0 + \delta, \tag{3.3}$$

where k_0 is the presumed expected enhancement in skills underpinned by the practice experience in the host country, and the random variable δ measures deviation from the expected increase in skills and follows a normal distribution: $\delta \sim N(0, \sigma_\delta^2)$. The variable δ is assumed to be independent of original skills, v, and remains unknown to professionals until they migrate to the host country. Accordingly, it implies the uncertainty of professional development and training opportunities, or rather the uncertain component in migration decisions.

Health professionals may either return to the donor country or continue to remain in the host country after completing the time-limited contracts of employment. Ignoring discounting and using a first-order approximation, the log earnings for temporary immigrants are given by:

$$w_{1,0} = \pi w_1 + (1 - \pi)(w_0 + \eta k). \tag{3.4}$$

Similarly, professionals who reside in the host country permanently will face the earnings distribution:

$$w_{1,1} = \pi w_1 + (1 - \pi)(w_1 + k). \tag{3.5}$$

Professionals seek to maximize their expected earnings, relative to migration costs along with permanent residence costs in the host country. So the migration decisions can be derived as follows:

"Migrate" if:

$$Ew_{1,0} - M > w_0 \quad \text{and} \tag{3.6}$$

"Migrate and not return" if:

$$Ew_{1,0} - M > w_0 \quad \text{and} \quad w_{1,1} - R > w_{1,0}, \tag{3.7}$$

where *M* gives a "time-equivalent" measure of costs of migrating to the host country, and *R* gives "time-equivalent" costs of switching temporary migration for permanent residence. Given the investment motivation of professional development and training, we assume that a professional emigrates as long as her expected wage from temporary migration, net of migration costs, exceeds the wage in the donor country; and once earning foreign practice experience, she then decides whether to return or remain according to benefits received from the experience: those facing better opportunities in the host country, net of permanent residence costs, than in the donor country tend to remain permanently.

The equilibrium sorting of health professionals based on the above migration decisions is:

"Stay in country 0" if:

$$(1-\eta)v \leq (\mu_0 - \mu_1 + \eta k_0) + \frac{M - \eta k_0}{\pi}, \tag{3.8}$$

"Migrate to country 1" if:

$$(1-\eta)v > (\mu_0 - \mu_1 + \eta k_0) + \frac{M - \eta k_0}{\pi}, \tag{3.9}$$

"Migrate and then return to country 0" if:

$$\begin{aligned}(\mu_0 - \mu_1 + \eta k_0) + \frac{M - \eta k_0}{\pi} &< (1-\eta)v \\ &\leq [\mu_0 - \mu_1 - (1-\eta)k_0] + \frac{R}{1-\pi} - (1-\eta)\delta \quad \mathit{and}\end{aligned} \tag{3.10}$$

“Migrate and then remain in country 1" if:

$$(1-\eta)(v+\delta) > [\mu_0 - \mu_1 - (1-\eta)k_0] + \frac{R}{1-\pi}. \tag{3.11}$$

The probability of migration, p, and probability of permanent migration, q, are given by:

$$\begin{aligned} p &= \Pr\left((1-\eta)v > (\mu_0 - \mu_1 + \eta k_0) + \frac{M-\eta k_0}{\pi}\right) \\ &= 1 - \Phi\left(\frac{(\mu_0-\mu_1+\eta k_0)+\frac{M-\eta k_0}{\pi}}{|1-\eta|\sigma_v}\right) \quad \text{and} \end{aligned} \tag{3.12}$$

$$\begin{aligned} q &= \Pr\left((1-\eta)(v+\delta) > (\mu_0 - \mu_1 - (1-\eta)k_0) + \frac{R}{1-\pi}\right) \\ &= 1 - \Phi\left(\frac{[\mu_0-\mu_1-(1-\eta)k_0]+\frac{R}{1-\pi}}{|1-\eta|\sqrt{\sigma_v^2+\sigma_\delta^2}}\right), \end{aligned} \tag{3.13}$$

where Φ is the standard normal distribution function. In particular, the derivatives of p and q with respect to various exogenous parameters are as follows:

$$\frac{\partial \mathrm{p}}{\partial \mathrm{k}_0} > 0; \tag{3.14}$$

$$\frac{\partial q}{\partial k_0} > 0 \text{ if } \eta < 1, \text{ and } \frac{\partial q}{\partial k_0} < 0 \text{ if } \eta > 1; \tag{3.15}$$

$$\frac{\partial p}{\partial \pi} > 0 \text{ if } \eta < \frac{M}{k_0}, \text{ and } \frac{\partial p}{\partial \pi} < 0 \text{ if } \eta > \frac{M}{k_0}; \tag{3.16}$$

$$\frac{\partial q}{\partial \pi} < 0. \tag{3.17}$$

The migration rate depends positively on how much health professionals are expected to benefit through the practice experience in the host country (shown in the derivative in 3.14). The permanent migration rate, on the other hand, depends positively on enhanced skills if the donor country values skills less (i.e. $\eta < 1$), and negatively otherwise (shown in the derivatives in 3.15). That is to say, for positively selected migrants, the more they could benefit, the more they are willing to remain; while for the negatively selected migrants, the more they could benefit, the more they are willing to return. The duration of training programs or contracts can also affect the (permanent) migration rate. Professionals prefer to move to countries offering longer programs when the increased wages in the home country less than compensates for migration costs (i.e. $\eta < \frac{M}{k_0}$); and vice versa (shown in the derivatives in 3.16). The permanent migration rate, on the other hand, falls regardless when the duration of training programs is extended (shown in the derivative in 3.17). Professionals who decide to migrate permanently wish to receive the investment on human capital as soon as possible.

The implications for skill composition of medical migration flows can be drawn from the selection bias of migrant professionals relative the average professionals. Define

$$z_M = \frac{(\mu_0 - \mu_1 + \eta k_0) + \frac{M - \eta k_0}{\pi}}{|1-\eta|\sigma_v} \quad \text{and} \quad z_R = \frac{[\mu_0 - \mu_1 - (1-\eta)k_0] + \frac{R}{1-\pi}}{|1-\eta|\sqrt{\sigma_v^2 + \sigma_\delta^2}}. \tag{3.18}$$

The selection bias of migrant professionals S_1, and the selection bias of permanent migrant professionals, S_2, are given by:

$$\begin{aligned} S_1 &= E\left(v \middle| (1-\eta)v > (\mu_0 - \mu_1 + \eta k_0) + \frac{M - \eta k_0}{\pi}\right) \\ &= \frac{1-\eta}{|1-\eta|}\sigma_v \lambda(z_M) \quad \text{and} \end{aligned} \tag{3.19}$$

$$\begin{aligned} S_2 &= E\left(v + \delta \middle| (1-\eta)(v+\delta) > [\mu_0 - \mu_1 - (1-\eta)k_0] + \frac{R}{1-\pi}\right) \\ &= \frac{1-\eta}{|1-\eta|}\sqrt{\sigma_v^2 + \sigma_\delta^2}\,\lambda(z_R), \end{aligned} \tag{3.20}$$

where $\lambda(z) = \frac{\phi(z)}{1-\Phi(z)}$ and ϕ is the density function of the standard normal distribution. We can then decide whether the average (permanent) migrant is better or worse off than the average professional in the donor country according to the sign of (permanent) selection biases. A similar self-selection process for health professionals can be summarised using the terminology of Borjas (1987) and Borjas and Brasberg (1996): if skills are valued more highly in the host country than in the donor country (i.e. $\eta < 1$), health professionals with higher skills tend to migrate (i.e. $S_1 > 0$), and among these positive-selected migrants those most skilled tend to migrate permanently (i.e. $S_1 > 0$ and $S_2 > 0$); and vice versa.

Existing models (Borjas 1999; Borjas and Bratsberg 1996) in general base discussions on the assumption that costs of migration remain constant in the population, and ignore the possibility that migration costs are able to determine whether immigrants are drawn from the upper or lower tail of the skill distribution. The restrictive relicensing and regulatory regimes for the migration of health professionals, as documented in Chapter 2, might make migration costs and permanent residence costs vary among professionals. More specifically, the restrictive relicensing regime imposes additional costs of relicensing on migrant professionals, involving out-of-pocket costs (e.g., tuition and registration fees) and psychological costs (e.g., the efforts expended in meeting relicensing requirements) (Kugler and Sauer, 2005); the requirement of work permits imposes psychological costs (e.g., the efforts expended in obtaining a work permit), out-of-pocket costs (e.g., fees of extending visa and work permit) and opportunity costs (e.g., the foregone wages the professional could have earned if return to home country). Higher skilled professionals are likely to feel it relatively easier to meet relicensing requirements and find a long-term employment, and bear relatively higher forgone wages. Accordingly, we can assume the skill level is negatively correlated with the psychological costs of acquiring a license and finding a long-term employment, but positively correlated with the opportunity costs.

To reflect the skill-related moving costs, we assume that:

$$M = M_0 + \alpha v \quad \text{and} \quad R = R_0 + \beta(v + \delta), \tag{3.21}$$

where M_0 and R_0 measures the out-of-pocket costs and the skill-independent component of psychological costs (e.g., the reluctance to leave behind family ties and social networks).

The sign of parameter α and β are determined by correlation between skill levels and the sum of opportunity costs and the rest psychological costs in the relevant migration process.

The migration decision rules of health professionals then become:

"Stay" if:

$$\left(1-\eta-\frac{\alpha}{\pi}\right)v \leq (\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi}, \tag{3.22}$$

"Migrate" if:

$$\left(1-\eta-\frac{\alpha}{\pi}\right)v > (\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi} \quad \text{and} \tag{3.23}$$

"Migrate and then remain" if:

$$\left(1-\eta-\frac{\beta}{1-\pi}\right)(v+\delta) > [\mu_0-\mu_1-(1-\eta)k_0]+\frac{R_0}{1-\pi}. \tag{3.24}$$

3.3 INFLUENCES ON THE SELF-SELECTION OF MIGRANT HEALTH PROFESSIONALS

3.3.1 General comparative Statics

Using the model laid out in the previous section, we explore the implications of the income-maximization hypothesis separately for the scale and skill composition of the self-selected migration flow. First, the new probabilities of migration and permanent migration are:

$$\begin{aligned} p &= \Pr\left(\left(1-\eta-\frac{\alpha}{\pi}\right)v > (\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi}\right) \\ &= 1-\Phi\left(\frac{(\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|\sigma_v}\right) = 1-\Phi(z_M) \quad \text{and} \end{aligned} \tag{3.25}$$

$$\begin{aligned} q &= \Pr\left(\left(1-\eta-\frac{\beta}{1-\pi}\right)(v+\delta) > (\mu_0-\mu_1-(1-\eta)k_0)+\frac{R_0}{1-\pi}\right) \\ &= 1-\Phi\left(\frac{[\mu_0-\mu_1-(1-\eta)k_0]+\frac{R_0}{1-\pi}}{\left|1-\eta-\frac{\beta}{1-\pi}\right|\sqrt{\sigma_v^2+\sigma_\delta^2}}\right) = 1-\Phi(z_R). \end{aligned} \tag{3.26}$$

where $z_M = \frac{(\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|\sigma_v}$ and $z_R = \frac{[\mu_0-\mu_1-(1-\eta)k_0]+\frac{R_0}{1-\pi}}{\left|1-\eta-\frac{\beta}{1-\pi}\right|\sqrt{\sigma_v^2+\sigma_\delta^2}}$. z_M is positive if $\pi\mu_1 + (1-\pi)(\mu_0+\eta k_0) - M_0 < \mu_0$, i.e. average professionals in the donor country could not benefit from migration, and negative otherwise. Analogously, z_R is positive if $(1-\pi)(\mu_1+k_0)-R_0<(1-\pi)(\mu_0+\eta k_0)$, i.e. average migrant professionals could not benefit from permanent migration, and negative otherwise. The qualitative effects of migration costs and permanent residence costs on these probabilities are given by:

$$\frac{\partial p}{\partial M_0}<0; \tag{3.27}$$

$$\frac{\partial p}{\partial \alpha}<0 \text{ if } 1-\eta-\frac{\alpha}{\pi}>0, \text{ and } \frac{\partial p}{\partial \alpha}>0 \text{ if } 1-\eta-\frac{\alpha}{\pi}<0; \tag{3.28}$$

$$\frac{\partial q}{\partial R_0}<0; \tag{3.29}$$

$$\frac{\partial q}{\partial \beta}<0 \text{ if } 1-\eta-\frac{\beta}{1-\pi}>0, \text{ and } \frac{\partial q}{\partial \beta}>0 \text{ if } 1-\eta-\frac{\beta}{1-\pi}<0. \tag{3.30}$$

The share of migration in the population falls when skill-independent costs (e.g. out-of-pocket costs and reluctance to leave behind family ties and social networks) rises (show in the derivative in 3.27). In addition, the migration share decreases with the correlation between costs and skill level in case of positive selection (i.e. $1-\eta-\frac{\alpha}{\pi}>0$); and increases with the correlation in case of negative selection (i.e. $1-\eta-\frac{\alpha}{\pi}<0$) (show in the derivatives in 3.28). Similar conclusions can be drawn for the self-selection process of permanent migrant professionals.

The implications for skill composition of medical migration flows, on the other hand, can be drawn from the selection bias of migrant professionals relative the average professionals. The selection bias of migrant professionals, S_1, and the selection bias of permanent migrant professionals, S_2, are given by

$$\begin{aligned} S_1 &= E\left(v\middle|\left(1-\eta-\frac{\alpha}{\pi}\right)v>(\mu_0-\mu_1+\eta k_0)+\frac{M_0-\eta k_0}{\pi}\right) \\ &= \frac{1-\eta-\frac{\alpha}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|}\sigma_v\lambda(z_M) \quad \text{and} \end{aligned} \tag{3.31}$$

$$S_2 = E\left(v+\delta \middle| \left(1-\eta-\frac{\beta}{1-\pi}\right)(v+\delta) > [\mu_0-\mu_1-(1-\eta)k_0]+\frac{R_0}{1-\pi}\right)$$
$$= \frac{1-\eta-\frac{\beta}{1-\pi}}{\left|1-\eta-\frac{\beta}{1-\pi}\right|}\sqrt{\sigma_v^2+\sigma_\delta^2}\lambda(z_R). \qquad (3.32)$$

As we can see from Equation 3.31, the introduction of skill–related migration costs set a new critical value for the self-selection process of medical migration: migration flows are positively selected if $1-\eta-\frac{\alpha}{\pi}>0$, and negatively selected if $1-\eta-\frac{\alpha}{\pi}<0$. That is to say, a higher skill premium in the lower income donor country (i.e. $\eta>1$) does not necessarily imply negative selection, and vice versa. Take the situation of $1<\eta< 1-\frac{\alpha}{\pi}$ for example. With negative skill-related migration costs(i.e. $\alpha<0$), the incentives to migrate for those who are worse off may decline due to their relatively higher migration costs, while those at the upper tail of the income distribution may be willing to migrate, such that migrant professionals are positive selected even though the host country taxes highly skilled professionals and subsidizes less skilled professionals relative to the donor country (i.e. $\eta>1$). Similar conclusions can be drawn for the self-selection process of permanent migrant professionals.

The impacts of any variable x on the average quality of migrants and permanent migrants can be found by differentiating the selection bias of (permanent) migrant professionals, $S_1(S_2)$, with respect the variable:

$$\frac{\partial S_1}{\partial x} = \frac{1-\eta-\frac{\alpha}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|}\lambda\frac{\partial\sigma_v}{\partial x}+\frac{1-\eta-\frac{\alpha}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|}\sigma_v\frac{\partial\lambda}{\partial x} \quad \text{and} \qquad (3.33)$$

$$\frac{\partial S_2}{\partial x} = \frac{1-\eta-\frac{\beta}{1-\pi}}{\left|1-\eta-\frac{\beta}{1-\pi}\right|}\lambda\frac{\partial\sqrt{\sigma_v^2+\sigma_\delta^2}}{\partial x}+\frac{1-\eta-\frac{\beta}{1-\pi}}{\left|1-\eta-\frac{\beta}{1-\pi}\right|}\sqrt{\sigma_v^2+\sigma_\delta^2}\frac{\partial\lambda}{\partial x}. \qquad (3.34)$$

The first term captures the effect of a change in the skill composition for a constant scale of (permanent) migration, or what is termed the “composition effect”, and the second term captures the effect of a change in the scale of (permanent) migration for a given skill composition, or the "scale effect" (Borjas, 1987). Tables 3.1 and 3.2 summarise the comparative statics results under various regimes.

Table 3.1: Summary of comparative statics results for migration.

		Positive Selection $1-\eta-\frac{\alpha}{\pi}>0$	Negative Selection $1-\eta-\frac{\alpha}{\pi}<0$
$\frac{\partial S_1}{\partial(\mu_1-\mu_0)}$	Composition Effect	none	none
	Scale Effect	–	+
$\frac{\partial S_1}{\partial k_0}$	Composition Effect	none	none
	Scale Effect	–	+
$\frac{\partial S_1}{\partial M_0}$	Composition Effect	none	none
	Scale Effect	+	–
$\frac{\partial S_1}{\partial \alpha}$	Composition Effect	none	none
	Scale Effect $z_M>0$	+	+
	$z_M<0$	–	–
$\frac{\partial S_1}{\partial \eta}$	Composition Effect	none	none
	Scale Effect $z_M>0$	?	–
	$z_M<0$	–	?
$\frac{\partial S_1}{\partial \sigma_v}$	Composition Effect	+	–
	Scale Effect $z_M>0$	–	+
	$z_M<0$	+	–

The impact of a change in the expected return to the practice experience in the host country on the average skills of migration professionals is given by:

$$\frac{\partial S_1}{\partial k_0}=\frac{\eta\left(1-\frac{1}{\pi}\right)}{1-\eta-\frac{\alpha}{\pi}}\frac{\partial\lambda}{\partial z_M}. \tag{3.35}$$

Shifts in the expected return to the foreign practice experience only have a scale effect on the skill composition of migrant professionals. An increase in k_0 increases the migration rate, which in turn decreases the average skills of positive-selected migrant professionals and increases the average skills of negative-selected migrants.

The impact of a change in the rate of return to skills in the donor country relative to the host country is given by:

$$\frac{\partial S_1}{\partial \eta}=\left(\frac{k_0\left(1-\frac{1}{\pi}\right)}{\left|1-\eta-\frac{\alpha}{\pi}\right|}+\frac{\sigma_v z_M}{1-\eta-\frac{\alpha}{\pi}}\right)\frac{\partial\lambda}{\partial z_M}. \tag{3.36}$$

The scale effect of the relative return to skills in the donor country is negative if migrant professionals are positively selected and average professionals in the donor country could benefit from migration (i.e. $z_M < 0$), or if migrant professionals are negatively selected and average professionals in the donor country could not benefit from migration (i.e. $z_M > 0$). Otherwise, the direction of the effect is ambiguous.

Finally, the impact of a change in the inequality of earnings is given by:

$$\frac{\partial S_1}{\partial \sigma_v} = \frac{1-\eta-\frac{\alpha}{\pi}}{\left|1-\eta-\frac{\alpha}{\pi}\right|}\lambda + \frac{\left|1-\eta-\frac{\alpha}{\pi}\right|}{1-\eta-\frac{\alpha}{\pi}}\frac{\partial \lambda}{\partial z_M} z_M. \tag{3.37}$$

The composition effect depends on the sign of $1-\eta-\frac{\alpha}{\pi}$. An increase in income inequality improves the earnings of the high skilled, making these better-off more likely to migrate if they can benefit from the migration and more likely to stay if they cannot benefit from the migration. Hence, the migration flow will include more professionals from the upper tail of the distribution if positive selection occurs, but also more professionals from the lower tail of the distribution if negative selection occurs. The scale effect has the same sign as the composition effect if average professionals in the donor country could benefit from migration (i.e. $z_M < 0$), and the opposite sign if average professionals in the donor country could not benefit from migration (i.e. $z_M > 0$).

Similar conclusions can be drawn for the self-selection process of permanent migrant professionals except the impact of expected return to the foreign practice experience, given by:

$$\frac{\partial S_2}{\partial k_0} = \frac{\eta-1}{1-\eta-\frac{\beta}{1-\pi}}\frac{\partial \lambda}{\partial z_P}. \tag{3.38}$$

The scale effect of the expected return to the foreign practice experience on the average skills of permanent migrants is negative if $\eta < \min\left(1, 1 - \frac{\beta}{1-\pi}\right)$ or $\eta > \max\left(1, 1 - \frac{\beta}{1-\pi}\right)$, and positive if $1 < \eta < 1 - \frac{\beta}{1-\pi}$ or $1 - \frac{\beta}{1-\pi} < \eta < 1$.

Table 3.2: Summary of comparative statics results for permanent migration.

		Positive Selection $1-\eta-\frac{\beta}{1-\pi}>0$	Negative Selection $1-\eta-\frac{\beta}{1-\pi}<0$
$\frac{\partial S_2}{\partial(\mu_1-\mu_0)}$	Composition Effect	none	none
	Scale Effect	–	+
$\frac{\partial S_2}{\partial k_0}$	Composition Effect	none	none
	Scale Effect	– if $\eta < 1$	– if $\eta > 1$
		+ if $\eta > 1$	+ if $\eta < 1$
$\frac{\partial S_2}{\partial R_0}$	Composition Effect	none	none
	Scale Effect	+	–
$\frac{\partial S_2}{\partial \beta}$	Composition Effect	none	none
	Scale Effect $z_P > 0$	+	+
	$z_P < 0$	–	–
$\frac{\partial S_2}{\partial \eta}$	Composition Effect	none	none
	Scale Effect $z_P > 0$	?	–
	$z_P < 0$	–	?
$\frac{\partial S_2}{\partial \sigma_v}$	Composition Effect	+	–
	Scale Effect $z_P > 0$	–	+
	$z_P < 0$	+	–
$\frac{\partial S_2}{\partial \sigma_\delta}$	Composition Effect	+	–
	Scale Effect $z_P > 0$	–	+
	$z_P < 0$	+	–

3.3.2 The relative returns to skills

In the general formulation of this model, a key determinant of the self-selection process is the relative returns to skills between the donor and host countries, η, which is measured as "the ratio of household income of the top 10 percent of the households to the income of the bottom 20 percent of the households" for general workers (Borjas, 1987, pp. 545). However, within the health sector, measurement of this parameter is clearly an issue with the lack of available and comparable data on incomes and occupational classifications (Dräger, DalPoz and Evans, 2006).

The best information we find is an OECD health paper by Fujisawa and Lafortune (2008), which compares the remuneration ratios of specialists to GPs for 11 OECD countries using OECD Health Data 2007. As can be seen in Table 3.3, there are significant variations in the remuneration levels of specialists to GPS across countries, ranging from 90% in Czech Republic, the same level in Iceland, up to more than twice in Netherlands. Facing these large variations, GPs are more likely to move to countries with lower ratios of remuneration between specialists and GPs, while specialists are more likely to move to countries with higher ratios. In particular, the UK offers a small remuneration difference (1.3 times) even though the gap in the length of training periods is quite long (4-7 years) compared with other countries, Netherlands, for instance, offering 1.4 times more remuneration for additional 4-6 years of training. This may provide GPs with higher incentives to move into the UK than specialists, resulting in a negative selection of doctors between grades from most of the countries with available data, such as Netherlands, Luxembourg, France, Austria, Canada, United States and Finland. Indeed, as highlighted in Chapter 2, migrants contribute less to consultant level posts, constituting 28% of consultants who work in the HCHS of the NHS in England, compared with 74% of staff grades and 40% of doctors in training and equivalents.

As to within grade income difference, no relevant data is available at all. The review conducted by Simoens and Hurst (2006) for physician remuneration methods in the OECD countries suggests that, for countries where the health care system is funded through taxation, primary care physicians tend to be paid by salary set centrally (e.g. Greece, Portugal, Spain and Sweden) or at least paid by a mix of salary, capitation and fee-for-service (e.g. Australia, Denmark, New Zealand, Norway and the UK); while for countries where heath care is financed through insurance, physicians tend to provide services as independent contractors and be paid by fee-for-service systems (e.g. Austria, Belgium, France, Germany, Japan, Korea, Switzerland and the USA) (See Table 3.4 for details).

As experience had shown that salary payment fails to promote high quantity of health provision compared with capitation and fee-for-service, middle and upper income countries have made attempts to introduce performance-related payment based on outputs and outcome (e.g. Australia, Hungary, the United Kingdom, and the United States) (WHO, 2006). Lower income countries, on the other hand, also show some interest in the performance-related payment, but, constrained by the higher administrative costs and capacity, health professionals are still mainly paid by salary unrelated to performance in the public sector and fee-for-service in the private sector (WHO, 2006). It seems plausible to argue that, by paying the better performers and worse performers on the same salary scale, the salary payment system is likely to push those health professionals providing higher quantity/quality of treatment to join the performance-related payment system, more specifically, a positive selection of health professionals within grade from the public sector to the private sector, and from poor countries to rich countries.

Table 3.3: Number of years of medical training after secondary education and ratio of remuneration of specialists to remuneration of GPs, 2004 (or closest year available).

Country	GPs	Specialists	Training year difference	Ratio of remuneration
Netherlands	9	13-15	4-6	2.4
Luxembourg+++	-	-	-	2
France	9	10-12	1-3	1.7
Austria**	9	12	3	1.6
Canada*	10	12-15	2-5	1.5
United States*	11	11-15	0-4	1.5
Finland++	8	13-14	5-6	1.3
United Kingdom+	8-9	12-15	4-7	1.3
Switzerland***	11	11-13	0-2	1.1
Iceland***	7-11.5	13.5	2-6.5	1.0
Czech Republic*	8.5	11.5-13.5	3-5	0.9

+ 1999, ++ 2002, +++ 2003, * 2005, ** 2006, *** 2007.

Source: Fujisawa and Lafortune (2008), page 36.

Table 3.4: Physician Payment methods.

Countries	Primary care physicians	Ambulatory care specialists	Physicians in public hospital	Physicians in private hospital
Australia	75-80% by blended payment (mainly fee-for-service, 10% of income derived from capitation and target payments for immunisation).	Fee-for-service, with no limit on use of services and annual expenditure.	Blended payment (salary for treating public patients and fee-for-service for treating private patients in public hospital).	Fee-for-service and salary.
Austria	60% by fee-for-service and 40% by fee-for-service and capitation.	90% by fee-for-service, 10% by capitation and fee-for-service.	90% by salary and 10% by fee-for-service.	90% by fee-for-service and 10% by salary.
Belgium	Fee-for-service.	Fee-for-service.	Fee-for-service.	Fee-for-service.
Canada	Mainly by fee-for-service, some alternative payment methods.	Mainly by fee-for-service.		Majority by fee-for-service.
Denmark	Blended payment (63% of income from fee-for-service, 28% from capitation).	Not relevant.	Salary.	
England	86% by blended payment (capitation, practice allowance, fee-for-service for selected services, target payments for immunisation), 14% by fee-for-service for private work.	100% by salary for public patients, fee-for-service for private patients.	100% by salary for public patients, fee-for-service for private patients.	100% by fee-for-service.
France	Fee-for-service.	Fee-for-service.	Salary.	Fee-for-service.
Germany	100% by fee-for-service.	100% by fee-for-service.	Salary. Fee-for-service for private patients.	100% by salary.
Greece	Salary in public sector, fee-for-service in private sector.	Salary in public sector, fee-for-service in private sector.	Mainly by salary.	Blended payment (fee-for-service and salary).
Ireland	Fee-for-service if higher patient income, capitation if lower patient income.		Salary. Fee-for-service for treating privately insured patients in public hospital.	
Japan	Fee-for-service.	Salary for hospital outpatient services, fee-for-service for independent outpatient clinics.	Salary.	
Korea	100% by fee-for-service.	100% by fee-for-service.	100% by fee-for-service.	100% by fee-for-service.
Mexico	Salary in public sector, fee-for-service in private sector.	Salary in public sector, fee-for-service in private sector.	Salary.	Fee-for-service.
Netherlands	Fee-for-service if higher patient income, capitation if lower patient income.			Blended payment (salary and fee-for-service).
New Zealand	78% by fee-for-service and 22% by capitation.	Majority by salary.	Majority by salary.	Majority by fee-for-service, minority by salary.
Norway	Blended payment (70% of income from fee-for-service and 30% from capitation).	Salary and fee-for-service in public sector, fee-for-service in private sector.	Salary.	
Portugal	Salary in public sector, fee-for-service in private sector.		Salary.	Fee-for-service.
Slovak Republic	Blended payment (capitation and target payments for preventive care).	100% by fee-for-service.	100% by salary.	Fee-for-service.
Spain	Blended payment (85% of income from salary and 15% from capitation).	100% by salary.	100% by salary.	Mainly by fee-for-service.
Sweden	Salary.	Salary.	100% by salary.	100% by salary.
Switzerland	96% by fee-for-service and 4% by salary.	90% by fee-for-service, 10% by salary.	Fee-for-service, salary and blended payment (fee-for-service and salary).	Fee-for-service, salary and blended payment (fee-for-service and salary).
United States	Blended payment.	Blended payment.	Blended payment.	Blended payment.

Source: Simoens and Hurst (2006), page 45.

3.3.3 Migration and permanent residence costs

Besides the relative income distributions in donor and host countries, costs of migration and permanent residence also play an important role in determining the direction of self-selection, especially in the health sector with stringent regulatory regimes, professionals' skills are likely to influence their migration and permanent residence decisions. We start by considering the uncertainty of the professional development and training opportunities (i.e. δ), under the situation that migration costs are independent of skills (e.g. $\alpha = \beta = 0$).

Figure 3.1 illustrates migration decisions when $\eta < 1$ and $\eta > 1$. The migration threshold, v, and the permanent migration threshold, δ, are given by:

$$v = \frac{\mu_0 - \mu_1 + \eta k_0}{1-\eta} + \frac{M_0 - \eta k_0}{\pi(1-\eta)} \quad \text{and} \quad \delta = \frac{\mu_0 - \mu_1 - (1-\eta) k_0}{1-\eta} + \frac{R_0}{(1-\pi)(1-\eta)} - v. \qquad (3.39)$$

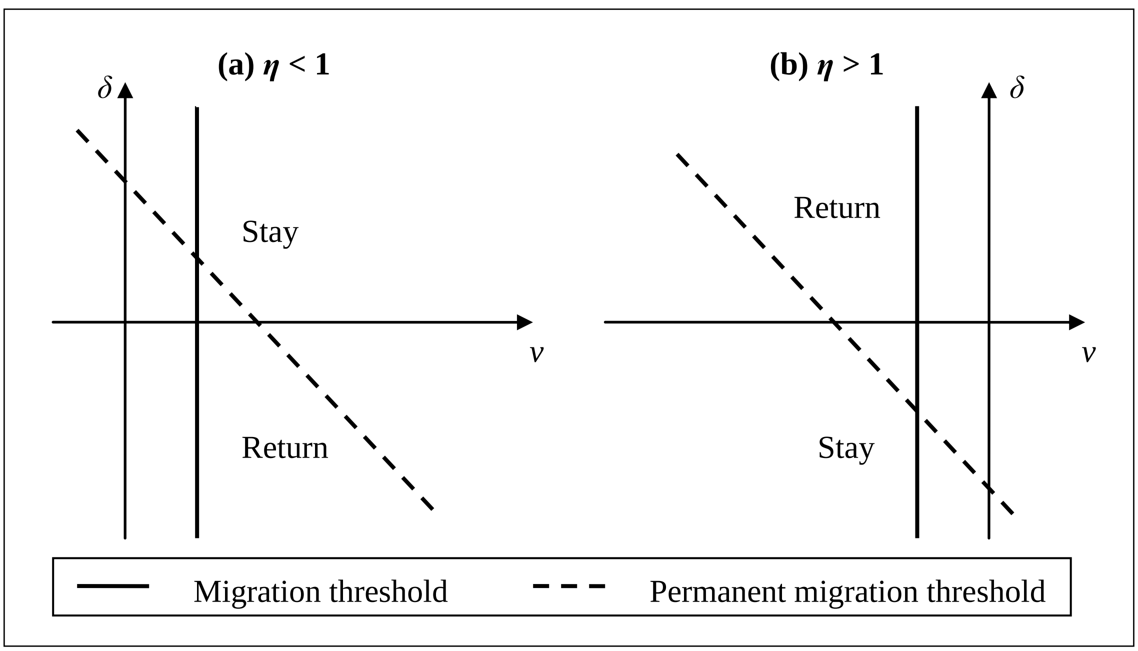


Figure 3.1: Skill sorting.

The return on the practice experience in the host country may vary in individual cases, and the decision of permanent residence depends on how much the professional can benefit from the experience. As Figure 3.1 indicates, if $\eta < 1$, a professional who has got both relatively higher original skills and increment skills from the practice experience will find it optimal to migrate permanently; and vice versa. As long as $cov(v, \delta) = 0$, the introduction of uncertainty in training leads to similar insights as the human capital model presented above: return migration intensifies the selection which characterizes the initial migration in terms of both original skills and increment skills.

For $\eta < 1$,

$$E(v|\text{Migrate and Stay}) > E(v|\text{Migrate and Return}),$$

$$E(\delta|\text{Migrate and Stay}) > E(\delta|\text{Migrate and Return}) \quad and$$

$$E(v + \delta|\text{Migrate and Stay}) > E(v + \delta|\text{Migrate and Return}).$$

For $\eta > 1$,

$$E(v|\text{Migrate and Stay}) < E(v|\text{Migrate and Return}),$$

$$E(\delta|\text{Migrate and Stay}) < E(\delta|\text{Migrate and Return}) \quad and$$

$$E(v + \delta|\text{Migrate and Stay}) < E(v + \delta|\text{Migrate and Return}).$$

Overall, permanent migrants have higher actual skills than return migrants in the case of positive selection; and lower actual skills, otherwise.

Skill-independent costs

We next consider the influence of changes in skill-independent migration costs and permanent residence costs (e.g. the out-of-pocket costs, and the independent-with-skill component of psychological costs such as the reluctance to leave behind family ties and social networks), again under the situation that migration costs are independent of skills (e.g. $\alpha = \beta = 0$). Consistent with earlier studies (Carrington, Detragiache, and Vishwanath, 1996), Figure 3.2 indicates that a higher (permanent) migration cost reduces the share of migrants in the population, which in turn increases the average skills of (permanent) migrants in case of positive selection, and decreases the average skills otherwise. Thus, countries could encourage migration flows through lowering M_0 and R_0, and limit migration through increasing M_0 and R_0.

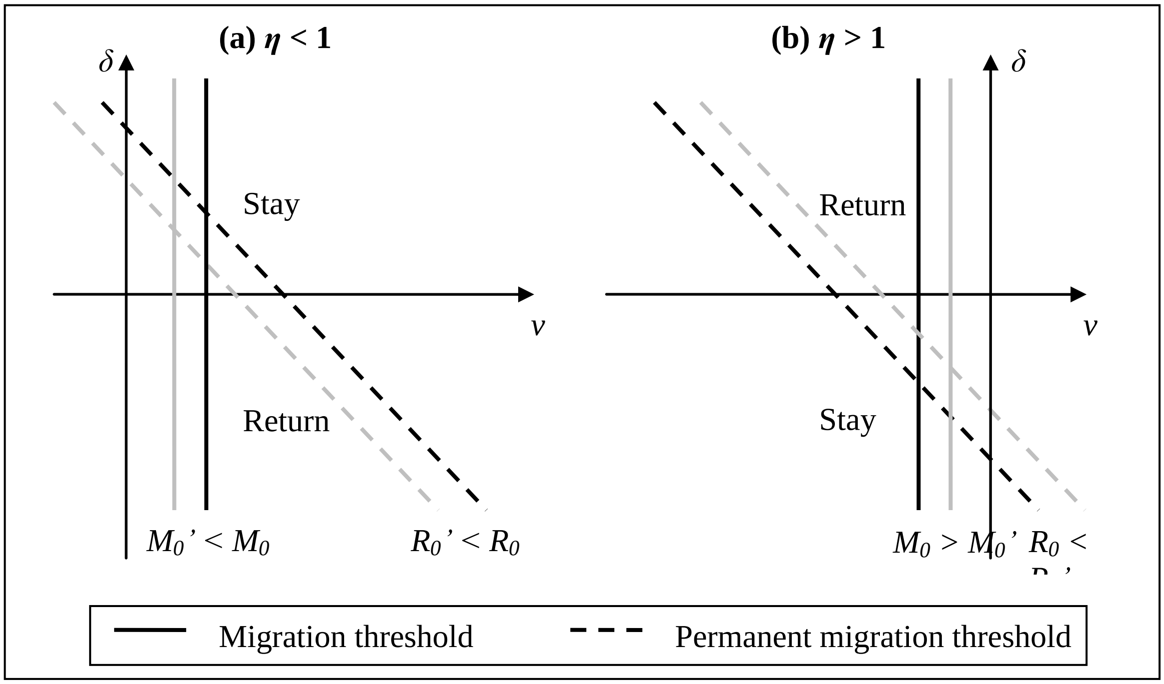


Figure 3.2: Influence of M_0 and R_0 on Skill Sorting (assuming α = β = 0).

Skill-related migration costs

Allowing for migration costs varying with skills, the migration threshold and permanent migration threshold then become:

$$v = \frac{\mu_0 - \mu_1 + \eta k_0}{1 - \eta - \frac{\alpha}{\pi}} + \frac{M_0 - \eta k_0}{\pi\left(1 - \eta - \frac{\alpha}{\pi}\right)} \quad \text{and} \quad \delta = \frac{\mu_0 - \mu_1 - (1-\eta)k_0}{1 - \eta - \frac{\beta}{1-\pi}} + \frac{R_0}{(1-\pi)\left(1 - \eta - \frac{\beta}{1-\pi}\right)} - v. \quad (3.40)$$

Thus, the migration threshold is determined by the coefficient between skills and migration costs (i.e. α), while the permanent migration threshold is determined by the coefficient between skills and permanent residence costs (i.e. β). In order to illustrate the effect of relicensing and regulatory regimes on international mobility of health professionals, we consider migration costs and permanent residence costs separately[6].

Figure 3.3 illustrates how the sign of α influences migration choices, assuming $\beta = 0$. Consider the threshold of positive selection for a donor country with $\eta < 1$ when migration costs are uncorrelated with skills as a benchmark (indicated as the black vertical line in Figure 3.3-a). A negative coefficient between skills and migration costs (i.e. $\alpha < 0$) leads "marginal stayers" with relatively lower skills than the average migrants to emigrate, which in turn increases the share, and decreases the average skills of the migration flow. Alternatively, in the case of a positive coefficient satisfying $1 - \eta - \frac{\alpha}{\pi} > 0$ (indicated as $\alpha > 0$), migrant professionals will be more skilled as a result of "marginal migrants" with less skills dropping out. In short, an increase in the correlation between skills and migration costs decreases the scale and increases the average skills of migrant professionals provided $1 - \eta - \frac{\alpha}{\pi} > 0$. However, it is worth emphasizing that a change in α can alter the form of original selection process. When the positive coefficient is large enough to turn $1 - \eta - \frac{\alpha}{\pi}$ into negative (indicated as $\alpha \gg 0$), the professionals with below-average skills are likely to migrate, while those immigrants who have relatively higher original skills and increment skills will remain in the host country. Hence, migrants are negatively selected even though the host country offers higher rewards to skills, although permanent migrants are still positively selected:

$$E(v|\text{Migrate and Stay}) > E(v|\text{Migrate and Return}),$$

$$E(\delta|Migrate\ and\ Stay) > E(\delta|Migrate\ and\ Return) \quad and$$

$$E(v + \delta|Migrate\ and\ Stay) > E(v + \delta|Migrate\ and\ Return).$$

[6] For simplicity, the remainder of the discussion is based on the assumption that average professionals in the donor country cannot benefit from migration (i.e. $z_M > 0$). Obviously, this assumption restricts the migration rate to less than half, which is fairly sensible in reality.

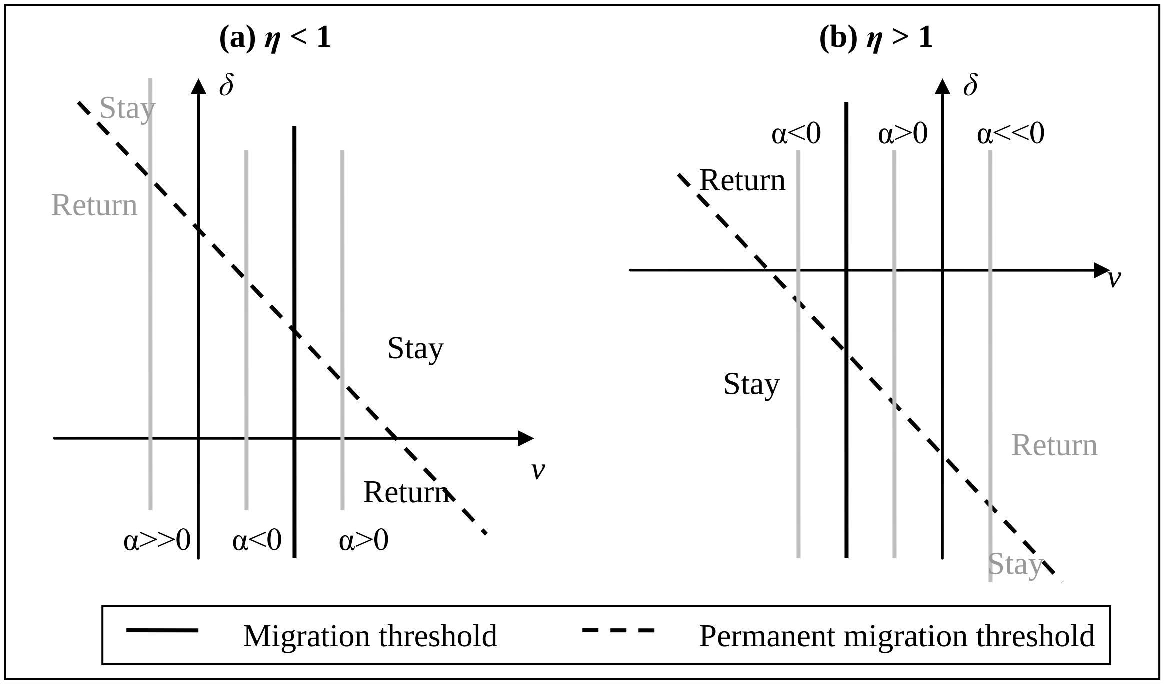


Figure 3.3: Influence of α on Skill Sorting (assuming β = 0).

It is noteworthy that the unchanged permanent migration threshold sets a higher standard of increment skills for migrants with lower original skills. Among the lower skilled migrants, only those who receive a relatively higher return from the practice experience can benefit from permanent migration. Lower skilled migrant professionals have to expend more effort to bridge the gap in skills and obtain further employment opportunities, while higher skilled professionals may choose to remain in the host country even though their increment skills are relatively lower. Therefore, the impact of α on the actual skills of permanent migrants, the sum of original skills and increment skills, remains ambiguous.

We then consider the case of negative selection for a donor country with $\eta > 1$ when migration costs are uncorrelated with skills (indicated as the black vertical line in Figure 3.3-b). An increase in the correlation between skills and migration costs increases the scale and average skills of migrant professionals provided $1 - \eta - \frac{\alpha}{\pi} < 0$. Similarly, in case of the negative correlation small enough to meet $1-\eta-\frac{\alpha}{\pi}>0$ (indicated as $\alpha \ll 0$), migrant professionals will be positively selected, while permanent migration are still negatively selected. This finding is consistent with recent studies by Chiswick (1999) and Brücker and Trübswetter (2004) that a more unequal income distribution in the lower income donor country does not necessarily imply negative selectivity.

Skill-related permanent residence costs

Finally, we allow for permanent residence costs varying with skills, and the permanent migration threshold is $\delta=\frac{\mu_0-\mu_1-(1-\eta)k_0}{1-\eta-\frac{\beta}{1-\pi}}+\frac{R_0}{(1-\pi)(1-\eta-\frac{\beta}{1-\pi})}-v$. Analogously, Figure 3.4 shows how the sign of β affects permanent migration choices, assuming $\alpha=0$. The actual skills of permanent migrants are determined by the sum of original skills and increment skills, or rather by the increment skills because the original skills of migrant professionals remain constant in the case of $\alpha=0$.

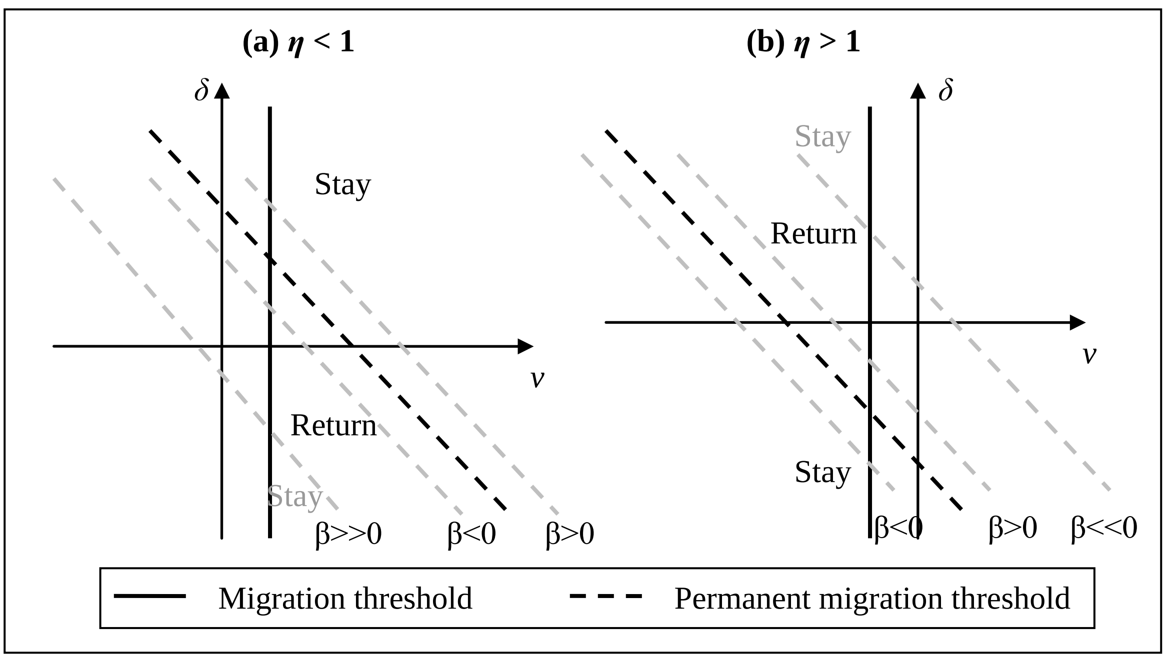


Figure 3.4: Influence of β on Skill Sorting (assuming α = 0).

For donor countries providing lower returns to skills (i.e. $\eta < 1$), an increase in the correlation between skills and permanent residence costs decreases the scale, and increases the average skills of permanent migrants, provided $1 - \eta - \frac{\beta}{1-\pi} > 0$. Otherwise, as the dash line ($\beta \gg 0$) indicates, the form of the selection characterizing permanent migration will be switched into a negative selection. In this situation, permanent migrants are negatively selected in term of both original skills and increment skills from the sample of the positive-selected migration flow.

Alternatively, in the case of donor countries providing higher returns to skills (i.e. $\eta > 1$), an increase in the correlation between skills and permanent residence costs increases the scale and average skills of permanent migrants provided $1 - \eta - \frac{\beta}{1-\pi} < 0$. Although, permanent migrants will be positively selected if $1 < \eta < 1 - \frac{\beta}{1-\pi}$ (indicated as $\beta \ll 0$).

Interpretation: outcomes of institution variables

We consider here the implications of various institutional variables on the scale and skill composition of migrant health professionals in the UK example.

- Country-to-country campaigns

To mitigate the adverse effects of medical migration, the UK government published the Code of Practice and encourages NHS employers to recruits migrant health professionals using country-to-country campaigns. This will lower M_0 and R_0 through the established network of previous migrants from the same country, thereby bring in more migrant professionals. However, the government should be careful that, as indicated in Figure 3.2, the increased scale of migration flows will be completely contributed by permanent migrants rather than temporary migrants if M_0 and R_0 are reduced at same level.

The model suggests that government intervention on permanent residence is necessary to avoid a "brain drain" from targeted countries.

- Relicensing and work permits

As with British citizens, EEA health professionals are automatically eligible for full registrations, except for some particular specialities; and free from immigration controls such as work permits. In this situation, migration costs involve psychological costs (e.g., the disutility associated with leaving behind family ties and social networks), out-of-pocket costs (e.g., commuting expenses, fees, and household goods), and opportunity costs (e.g., the foregone wages the professional could have earned when travelling, searching for a new job); and tend to be positively related with skills as the high-skilled generally bear higher forgone wages. Figures 3.3 and 3.4 suggest although it seems that the average skills of migrants from EEA would be increased by bringing in less positively selected health professionals and more negatively selected professionals, there exists a risk of turning positive selection into negative selection. For example, in countries such as Greece, Portugal, Spain and Sweden, where primary care physicians are paid by salary set centrally, (permanent) migrant physicians will not be positively selected if $1-\eta-\frac{\alpha}{\pi}<0$ ($1-\eta-\frac{\beta}{1-\pi}<0$). This happens with a large correlation between (permanent) migration costs and skills (e.g. high unemployment rates in the donor country) and a shorter (longer) duration of training programs or contracts.

Non-EEA professionals, on the other hand, have to meet the requirements of relicensing and work permits to practise in the UK. The migration costs involve psychological costs (e.g., the disutility associated with leaving behind family ties and social networks, the efforts expended in meeting relicensing requirements and obtaining a work permit), out-of-pocket costs (e.g., commuting expenses, fees, and household goods, tuition and registration fees and fees of applying for the visa and work permit), and opportunity costs (e.g., the foregone wages the professional could have earned when travelling, searching for a new job and training); while the permanent residence costs involve psychological costs (e.g. the disutility associated with leaving behind family ties and social networks, and the efforts expended in obtaining a work permit and finding a long-term employment in the host country), out-of-pocket costs (e.g. fees of extending visa and work permit, and household goods), and opportunity costs (e.g. the foregone wages the professional could have earned if return to home country). In this case, α is determined by the correlation between skills and the sum of opportunity costs, and psychological costs of acquiring a license and work permit, while β is determined by correlation between skills and the sum of opportunity costs, and psychological costs of acquiring a work permit and finding a long-term employment. Since more skilled professionals are likely to feel it relatively easier to meet relicensing requirements and obtain a work permit and spend relatively shorter time to find an employment, the restrictive relicensing regime and the change of the immigration rules may increase M_0 and R_0, and decrease α and β.

Similar to the pervious discussion, an increase in M_0 (R_0) decreases the scale of the (permanent) migration flow; increases the average skills of (permanent) migrants in the case of positive selection, and decreases the average skills in the case of negative selection. A decrease in α (β) decreases the average skills of (permanent) migrants; increases the scale of the (permanent) migration flow in the case of positive selection, and decreases the scale in the case of negative selection. Consequently, for donor countries that value skills more (e.g. Japan, Korea and USA where physicians are completely paid by fee-for-service), these regulations not only reduce the scale, but also the average skills of (permanent) migrant health professionals. Nevertheless, the model also suggests that it is possible to achieve positive selection by introducing a small negative correlation between (permanent) migration costs and skills, and a (longer) shorter duration of contracts and visas. For other donor countries, most likely with lower incomes and health professionals paid by salaries regardless of performance, the effects are ambiguous as the effects of M_0 and α (R_0 and β) are opposite.

The effects of relicensing on migration costs we have discussed so far solely focus on skills within grade. Effects on skills between grades are also of interest as the British government has shown strong intention to improve the recruitment and retention of consultants (Ikenwilo and Scott, 2007). The GMC sets separate registration requirements for GP registrars and specialist registrars, which means professionals in higher grade posts need to expend more efforts to meet relevant relicensing requirements. The diversity relicensing regimes increase α in the whole doctor category, and therefore, limit the inflow of senior professionals from countries offering higher remuneration difference between grades (e.g. Switzerland, Iceland and Czech Republic) and foster the inflow of junior professionals from countries otherwise.

- High unemployment rate in donor countries

Despite the global shortage of health staff, there are still a large number of unemployed professionals in many countries (WHO, 2006). For example, Germany is experiencing a surplus of physicians which is attributed to the education system (Kabene *et al.*, 2006); the health sector employments have been downsized in many countries implementing programmes of structural adjustment, such as Poland (Domagala *et al*., 2000 cited in Bach 2003), Uganda (Corkery, 2000 cited in Bach, 2003), Estonia, Latvia and Bulgaria (ILO, 2002 cited in Bach, 2003).

For health professionals from such countries with high unemployment rates, the lower skilled may bear lower, or even zero foregone wages if migrate or return to the donor country, and thus, the unavailability of employment opportunities in the donor country decrease M_0 and R_0, and increase α and β. In this situation, the effects of unemployment in the donor country on the scale and average skills of (permanent) migrant professionals are positive if the donor country values skills more (i.e. η >1); but ambiguous, otherwise. It is clear that countries with higher relative returns to skills should reduce the unemployment rate in the health sector to retain health professionals. In Germany, for example, where primary care physicians are paid by fee-for-service, the reform of the education system is necessary that places in medical school should be arranged centrally according to national demand.

3.4 CONCLUSION

This chapter has presented a theoretical analysis of (permanent) migration behaviour of health professionals. The self-selection model by Borjas and Bratsberg (1996) is extended to account for important characteristics that are specific to the health sector. As a specific group of highly skilled workers, health professionals have demonstrated strong motivation of continuous professional and personal development in the migration decision. The model suggests that countries with higher international recognition for the health service delivery and training system are in general more popular in the international health labour markets. Although the extent to which these professionals migrate on the temporary or permanent basis and their preferences in the duration of initial contracts and visas may differ between donor countries with different relative returns of skills, their intention to remain permanently reduces if the duration of contracts and visas extends.

By allowing for moving costs varying with skills, the extended model explicitly exploits the important role of various institution variables in determining the scale and skill composition of (permanent) migrant health professionals in the UK case. The country-to-country campaigns developed by the British government are likely to foster a further inflow of health professionals from targeted countries by lowering their moving costs with the established network of pervious migrants. The model suggests the stimulated inflow will be mainly composed of permanent migrants if migration costs and permanent residence costs change on the same extent, so government intervention on permanent residence is necessary to avoid a “brain drain”. In addition, the UK government has introduced restrictive requirements of relicensing and work permits for non-EEA health professionals to maintain the practice standards and secure employment opportunities for native graduates. These regulations, however, only limit the inflow of migrant health professionals from countries with higher returns to skills, although as well as their average skills. For most donor countries which provide lower returns to skills, the effect is ambiguous as effects of skill-independent costs and the correlation between skills and costs are opposite.

The general policy suggestion is to adopt performance-based payment mechanism and increase remuneration differences between grades to restrict the outflow of high-skilled health professionals and the inflow of low-skilled professionals. Furthermore, the assumption that migration costs vary among professionals with different skill levels provides new insights into the self-selection process: even though the donor country provides higher returns to skills, the host country could still achieve positive selection by (1) reducing migration costs for high-skilled professionals, and (2) shortening the duration of contracts and visas. The first can be simply achieved by setting higher relicensing requirement and increasing competition in the labour market, while the second is not recommended because, on the one hand, shorter contracts could attract more permanent migrants; on the other hand, it could potentially bring in a negative selection of EEA nationals, especially those from countries with high unemployment rate, for whom moving costs essentially depend on the forgone wages and are significantly positive related with skills.

An empirical analysis would be necessary to provide a more accurate and comprehensive assessment of the extent to which pull and push factors and institutions affect the scale and skill composition of (permanent) migrant health professionals. It would be ideal to have individual data concerning the donor country to investigate if those who emigrated are positively or negatively selected compared with those who stayed; or alternatively, use data of the host country to compare those migrants who returned with those who remained. However, such data are very limited not only in the health sector but also on general migrants. Much of the existing empirical literature examines the dynamics of post-migration wages for migrant workers relative to their native counterparts and draws inferences about selection from their assimilation experience in the host country (Hatton and Williamson, 2002). It is only recently that researchers have started examining internal migration using data which document the pre- and post-migration wages. Examples of these include the internal migration in the USA and Canada (Chiswick, 1999) and the east-west migration in Germany (Brücker and Trübswetter, 2004). Data collection is therefore, essential for governments, especially those of donor countries, to develop empirical evidence and appropriate strategies of regulating and monitoring the migration of health professionals.

Due to the lack of data availability, we are constrained from further empirical analysis of the economic influences on the migration decisions of health professionals, but move on to assess the impacts of migrant health professionals on the health care provision in the host country by investigating migrant professionals' performance in the remainder of this thesis.

CHAPTER 4
INSTITUTIONAL BACKGROUND AND DATA

The remaining parts of this thesis are concerned with assessing the impacts of the migration of health professionals on the health care provision in the host country. For policy makers who are concerned to ensure continuity of access to NHS health service, two questions could be of particular interest: (1) how long do migrant health professionals work in the NHS? and (2) how does the treatment they provide compare with domestically trained professionals? In the next two chapters, we shall make attempts to address these two questions in the context of the NHS General Dental Service in Scotland. This chapter provides the institutional background and the data source for subsequent empirical analyses.

The remainder of this chapter is organised as follows. The first section reviews some relevant features of dental service provision in the NHS and dental access schemes that have been launched in Scotland; the second section describes the administrative data we employ. The last section presents results of some descriptive analytics where we first monitor the size and composition of migrant dentist inflow into the Scottish NHS since 1996, and then investigate individual characteristics and career patterns of the recent cohorts of migrants relative to the Scottish vocational trainees who start working in the GDS at the same time.

4.1 NHS DENTAL SERVICES AND ACCESS SCHEMES IN SCOTLAND

Details of the dental service provision in the Scottish NHS have been set out by Chalkley and Tilley (2002). The key features that are relevant to this study are:

- Patients in Scotland receive dental services from both NHS and private providers. NHS dental services are delivered in a variety of arrangements, namely, the GDS, the Community Dental Service (CDS) and the Hospital Dental Service (HDS). The CDS provide services for adults with special needs and specific groups of children, as well as a safety-net function for those who are unable to access GDS; while the HDS provides highly specialised services for patients referred from both dental and medical practitioners and from other hospital services. They work together to meet the diverse needs of the population. The majority of dental services are undertaken by 'high street' primary care GDPs in the GDS, accounting for approximately 75% of the costs for all NHS dental services in Scotland (Scottish Executive, 2005).

- To receive treatment under the NHS, a patient visits and registers with a dentist, who is under an agreement with the GDS to provide NHS treatments. The costs of treatment are met in part by the NHS Boards, which receive government funds in order to meet the dental and medical health care needs of their constituent populations. Unlike most other NHS health services, dental services are not free at the point of delivery and patients contribute 80% of the treatment costs up to a cash limit unless exempt from charges, which can occur for a number of reasons.
- GDPs are predominantly independent contractors who treat patients on behalf of NHS Boards under a hybrid 'capitation' and 'fee-for-service' system. More specifically, in return for providing NHS dental services, self-employed GDPs receive a capitation (continuing care) fee for each child (adult) patient registered on their list, and a fee for each item of service they provide to patients. The complete menu of capitation (continuing care) payments and item of service payments are specified in an annual publication – the Statement of Dental Remuneration (SDR). These self-employed GDPs can freely decide on the quantity of NHS work they wish to undertake, and usually see a mix of NHS and private patients.

- NHS Boards may choose to create salaried posts if GDPs in their locality are not accepting NHS registrations, or if GDPs are only accepting for treatment those patients exempt from payment, or if there are no GDPs practising in an area. Salaried GDPs are directly employed at a fixed salary, unconditional on the number or types of services they carry out.

While dentists may work in one or more of the NHS dental services and/or the private sector, the GDS constitutes the primary career destination of dental graduates in Scotland (SCPMDE, 2004). Moreover, the detailed treatment data that we exploit in this thesis is only available from the GDS. Therefore, this study is focused solely on migration flow in the GDS. An important feature of the GDS, which is key to our study, is that items of treatment (e.g. examination, polish, filling, etc.) in every course of treatment (CoT) are recorded for payment purposes. It is therefore, possible to compare and contrast the treatments delivered by migrant dentists with those of non-migrant dentists in the GDS (see Chapter 6 for details).

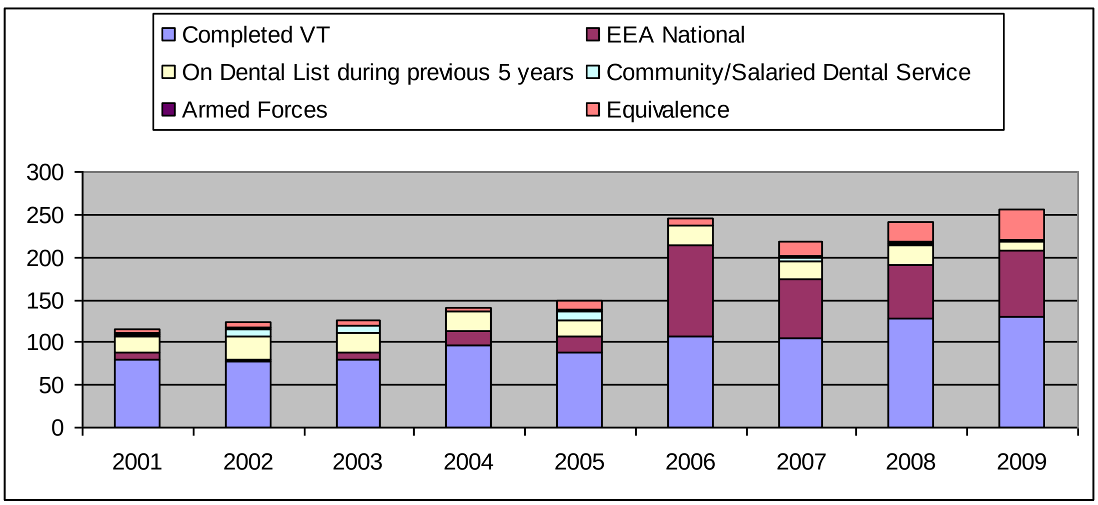
In order to practise dentistry in the GDS in Scotland, dentists need to obtain an NHS Board list number. To obtain a list number, dentists need to be issued with a Vocational Training (VT) number from NHS Education for Scotland to indicate that they have satisfactorily completed the VT[7] in the UK or are exempt from the requirement to complete VT because:

- they are from an EC/EEA Member State (other than the UK) and hold a recognised European Dental Diploma;
- they have had a Health Board/Performer number within the last five years;

[7] Typically, VT comprises 12 months of supervised clinical experience in an approved training practice supplemented by an educational programme.

- they have practised in primary dental care in the CDS or the Armed Forces for four years' full-time (or equivalent part-time), and for not less than four months during the past four years;
- they have completed a course of vocational training under the voluntary scheme; or
- their experience and or/training during the previous five years is equivalent to VT.

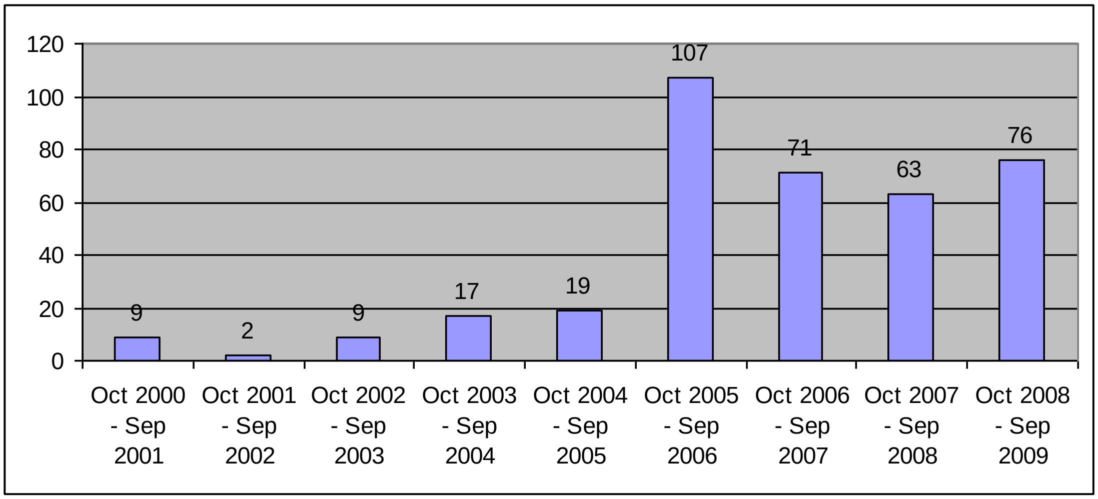
VT numbers are therefore a lead indicator of the inflow of dentists into NHS Scotland. Figure 4.1 shows that VT numbers issued have more than doubled during the past 9 years, particularly with a large and sustained increase since 2005-06. As also can be found, this increase is mainly contributed by the EEA nationals.



Source: NHS Education for Scotland.

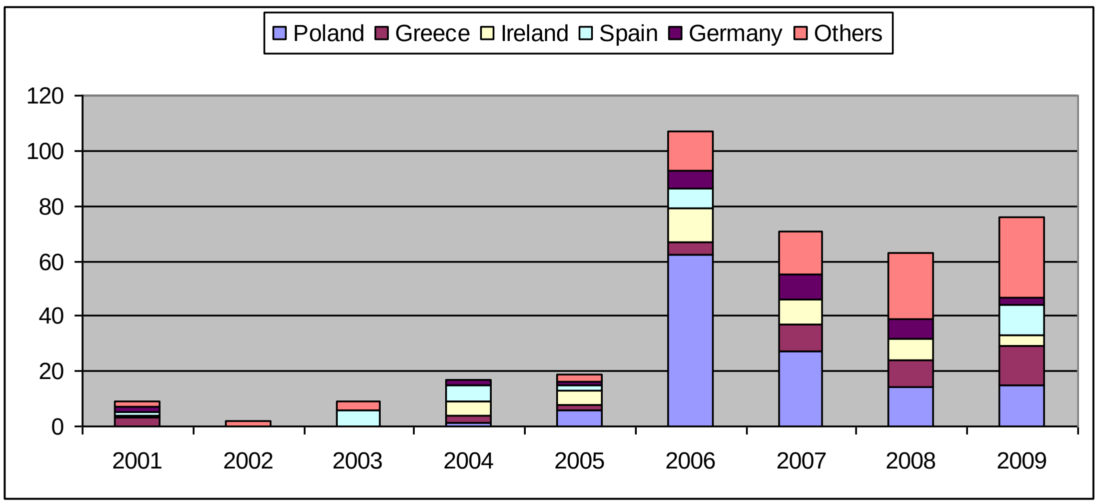
Figure 4.1: VT numbers issued from October 2000 to September 2009.

Figure 4.2 shows that there has been a large and sustained increase in VT numbers issued to EEA applicants, particularly in 2005-06. To put these numbers into context, the number of funded undergraduate dental students entering dental schools in Scotland in 2009-10 was 170. Applicants for a VT number apply from a wide range of European countries and Figure 4.3 illustrates the 5 most common countries of application since VT year 2001 (10/2000 – 09/2001). These EEA nationals comprise the migrant dentists in our study.



Source: NHS Education for Scotland.

Figure 4.2: The number of VT numbers issued to EEA nationals who hold a recognised European diploma.



Source: NHS Education for Scotland.

Figure 4.3: Applicants for VT numbers by country.

Despite these existing initiatives, Scottish patients, particularly those in the islands and the more remote, sparsely populated areas, have experienced problems in accessing NHS dental services. This problem has historically emerged as a result of the uneven distribution of dentists, and is escalating in recent years for reasons such as a reduction in commitment to the NHS on the part of some GDPs, and insufficient justification for the setting up of a full time practice due to a limited number of patients in some areas (Scottish Executive, 2007). As of 31 May 2000, it was estimated that only about 49% of Scottish adults and 66% of children are registered with GDPs for NHS dental services; the rest of the patients may receive dental services either from the CDS (about 10% of children), dental teaching hospitals (about 1% adults), or the private sector (about 14% adults), leaving a large proportion of the population not receiving any regular dental services at all (Scottish Executive, 2000)[8]. In particular, the private sector continues to grow – for instance, the number of patients receiving dental treatment from Denplan, the largest independent provider of dental service in the UK, increases from 51,502 in 2000 to 91,673 in 2008, while the NHS registration rates remain constant for children and reduce gradually for adults until 2008 (NES, 2008). This year has seen a significant rise in registration rates for both children and adults, which however, may also be a result of extending registration period from 15 to 36 months in April 2006.

In order to improve access to NHS dental services, the Scottish Executive published "An action plan for improving oral health and modernising NHS dental services in Scotland" (2005). The proposal outlines a range of workforce development measures to address the shortfall of over 200 dentists estimated in 2003/04 by 2008. This has included incentivising dentists to return to Scotland and recruiting from outside of Scotland; sustaining and developing salaried dental services; supporting and rewarding GDPs for NHS treatment provision; and expanding training capacity for dental professionals in Scotland (increasing by 15% to guarantee an output target of 135 by 2006). These efforts have proven successful in recent years and there are now 409 more dentists working in NHS Scotland in September 2008 (3,078) as compared to the number in September 2005 (2,669)[9]. Of the 3,078 dentists practising at September 2008, approximately 2,703 (88%)

[8] Chalkley and Tilley (2008) proposed the NHS participation rate within a specific time interval rather than upon a specific time point to measure the actual access to NHS dental services to account for various visit frequencies of patients. A much better access has been suggested that about 79% of adult have accessed NHS dental services between 1998 and 2006.

[9] NHSScotland Workforce Information published by ISD Scotland http://www.isdscotland.org/isd/5898.html.

work in the GDS, including 2,385 self-employed and 356 salaried. A further 475 dentists provide care in the CDS and 287 in HDS. These figures also suggest double counting of many dentists occurs as a result of cross-commitments between the three different services: for example, as many as 293 dentists work in joint salaried GDS/CDS posts.

One of the policy initiatives launched by the Scottish Executive was to employ about 35 dentists directly from Poland in 2006 to arrive in Scotland in three cohorts. The first cohort of 12 dentists was expected to treat about 20,000 patients in Fife, Forth Valley and Argyle & Clyde. The latter two cohorts practise in Orkney, Stornoway, the Borders, Argyle & Clyde and Dumfries & Galloway, and in Grampian, Highland, Tayside and Fife, respectively. These Polish dentists are employed on a three year contract with salaried dental service after satisfactorily completing an intensive eight week English course and attending a two week residential course (NES, 2006). These recruited Polish dentists account for some but by no means all of the VT numbers issued to migrant dentists since 2006.

4.2 MIDAS DATA

The anonymised treatment data reported in this paper comes from the Management Information & Dental Accounting System (MIDAS), which is a large-scale administrative database of linked patient-practitioner information maintained by the Practitioner Services Division to process, authorise and store all NHS GDS treatment in Scotland. The data is based upon mandatory claims for CoTs made by the entire population of practitioners in contract to the GDS over the last ten years for remuneration and audit, and therefore, offers an accurate reflection of treatments delivered.

Within each CoT, the patient usually receives a range of items of service, each with an associated fee determined annually in a bilateral bargain between dentists' representative and health boards. Following the Doctors' and Dentists' Review Body recommendations, items of service payments were initially based on the estimates on periodic reviews of the timings of treatment by the Dental Rates Study Group. Since 1996, however, payments have only been re-based in relation to the general price level so as to avoid distorted increases relative to the initial timing due to technical progress and productivity improvements (Chalkley & Tilley, 2002; 2006). In a word, the changes in these fees are informed by Doctors' and Dentists' Review Body but the level of the fees were historically set to make all treatment equally remunerative per unit of time. Thus, the total value of a claim, measured as the sum of fees for the individual items of services contained, reflects the time a dentist has spent treating a particular patient and constitutes a measure of treatment intensity.

The NHS payment system allocates a unique identifier for each patient, GDP, practice and CoT, making it possible to follow patients, GDPs and types of treatment over time. Information on the migrant status of dentists in the GDS comes from NHS Education for Scotland. The VT numbers issued by NHS Education for Scotland were linked to the treatment data using the GDC number of the dentist.

For each CoT, a relatively rich set of information is provided on different dimensions. MIDAS records the claim's value, payment month, and specifies its composition by including an indicator variable for each broad treatment category defined in the SDR (e.g. diagnostic, periodontal, conservative, surgical, prosthetic, etc). On the patient side, MIDAS contains information on the individual's date of birth, age at treatment, gender, and exemption status (exempt or non-exempt). The dentist characteristics that are provided include the age at treatment, gender, remuneration structure (self-employed or salaried). In addition, as dentists need to register with Practitioner Services for a list number for each practice where he/she works to process NHS transactions, the associated list number and the date on which the number was resigned are also contained in the claim. Finally, MIDAS records the NHS Board and the deprivation category of each practice which ranges from 1 (most affluent) to 7 (least affluent).

4.3 DESCRIPTIVE ANALYSIS: MIGRANT DENTISTS IN NHS SCOTLAND

4.3.1 Dentist inflows

For the purpose of our analysis we obtained a full sample covering all claims submitted by migrant dentists from the MIDAS database, which includes 445,033 claims made by 269 GDPs from 22 EC/EEA countries who provided treatment in the GDS between December 1996 and September 2008. By following each migrant dentist who has ever practised in the GDS, we can monitor the size and composition of migrant dentist inflow in the Scottish NHS since 1996.

Table 4.1 reports the number of migrant dentist inflow into the GDS by country of application for top six donor countries. From 1996 to 2005, while the number of migrants practising in the Scottish GDS increased steadily, there were only a handful of migrant GDPs joining the service each year. There is also no clear pattern of inflows across countries during that period. However, a contract to directly recruit 35 Polish salaried GDPs was achieved in 2006, and since then Scotland has seen a substantial increase in dental practitioner migration flows, with 92 migrant GDPs joining the service that single year. In particular, Poland has become a major donor country, and, together with Ireland, Greece and Germany, has contributed to three-quarters of the inflow of EEA migrant dentist during the period. The substantial immigration growth since 2006 highlights the importance of employment prospects and social networks to the supply of migrant dentists. As the active Polish recruitment scheme implemented by the Scottish Executive has signified sufficient employment opportunities, and together with the gradually constructed migrant networks in the GDS, a growing number of EC/EEA dentists are now attracted to migrate to Scotland at an individual level.

Table 4.1: Migrant dentist inflow in Scottish GDS by country.

Country	96	97	98	99	00	01	02	03	04	05	06	07	08[10]	Total
Poland									4	4	48	23	12	91
Ireland	1			1					5	4	11	8	7	37
Greece					2	2		1	2	2	7	7	10	33
Germany	1				1				1	1	8	5	5	22
Spain						1		6	6	3	6			22
Sweden		1	1	3		2	1			1	1	6	1	17
TOTAL	4	2	2	6	4	6	2	10	18	16	92	61	46	269

Table 4.2 shows the age distributions of the migration flow in the Scottish GDS over the past five years. Over 70% of migrant GDPs are less than 40 years old. However, the proportion of practitioners under 30 years old has dropped significantly from 61% in 2004 to 28% in 2007. The average age of migrant GDPs increased from 28 to 34 during the past five years. Figure 4.4 illustrates the gender composition of the entrants. The percentage of migrants who are female has fallen from over 60% to 46%.

Table 4.2: Age distribution of migrant dentists in the GDS (%).

Age Group	2004	2005	2006	2007	2008
<25	28	38	12	8	11
25-29	33	13	26	20	24
30-39	28	44	36	43	46
40-49	11	0	21	16	13
≥50	0	6	5	14	6
Average (SD)	28.4 (6.3)	29.4 (8.5)	33.9 (8.3)	35.9 (10.0)	33.7 (8.3)

[10] Please note that these figures only take account of those dentists who have started making claims in MIDAS before September, 2008.

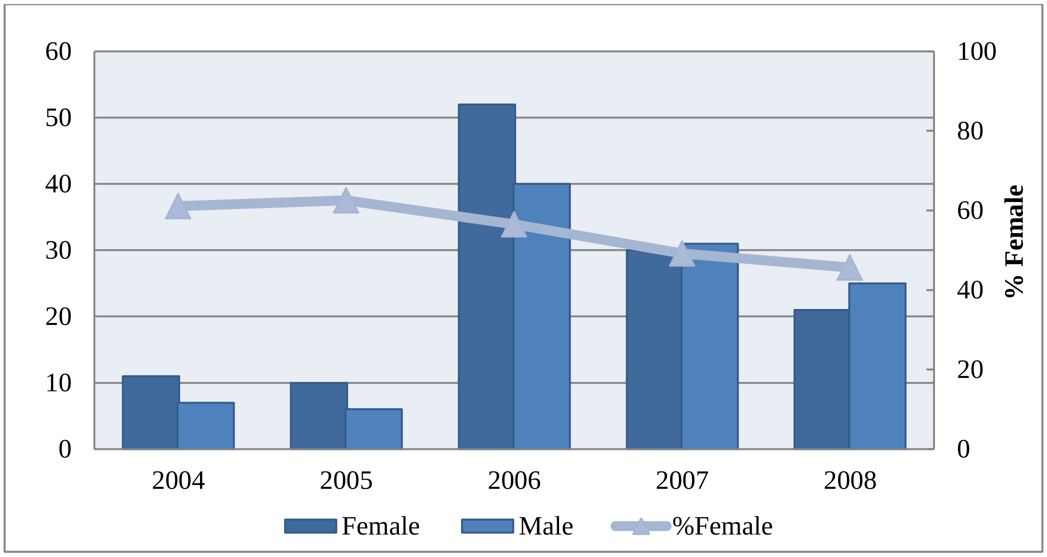


Figure 4.4: Gender breakdown of migrant dentists in the GDS.

4.3.2 Individual characteristics and career patterns

We further explore the payment data to compare the individual characteristics and career patterns between non-migrant and migrant GDPs. As GDPs in different periods facing different markets for dental services may choose different career patterns, and most of the migrant GDPs (199 out of 269) working in GDS arrived after 2006, we restrict our attention to the migrant dentists who began providing GDS treatment after January 2006, and select the non-migrant dentists who successfully completed VT in July 2006 and who subsequently provided treatment in the GDS as a comparison group. The treatment data for both migrant and non-migrant dentists were restricted to information on adults because there is much more detailed information on the treatment of adults compared to children. The initial sample consisted of 199 migrant GDPs with 264,843 claims and 83 non-migrant GDPs with 217,755 claims paid before September 2008. Given the different practice durations for the two groups (max. experience is 32 months for migrants and 25 months for non-migrants), we only focus on treatment provided within the first 24 months after entry.

This restricted the sample to 251,314 claims by migrant GDPs and 212,621claims by non-migrant GDPs.

Descriptive statistics for these recent cohorts of GDPs are presented in Table 4.3 and highlight some simple stylized facts in terms of three key features: dentist characteristics, practice characteristics, and dentist performance. The first two columns represent figures for non-migrant and migrant GDPs, while the left remaining five columns refer to migrants from four major donor countries, namely Germany, Greece, Ireland and Poland. In particular, the recruited and non-recruited Polish dentists are studied separately in order to evaluate the Polish recruitment scheme.

The first panel provides the descriptive information of dentist characteristics to illustrate whether the composition of the migration flow varies across countries and how these migrant dentists are remunerated in GDS. While migrant and non-migrant GDPs have similar gender breakdowns (percentage of female remains around 50%), there is a significant variation across different donor countries. Nearly three quarters of recruited Polish GDPs are female, compared with 28.9% for those from Greece. The next row of the table shows the average age at which GDPs provided the first treatment. The average age at entry of the migrant GDPs was 34.5, or 9 years older than the non-migrants. Among the migrant GDPs, the Irish and Greek are the youngest when joining the service (25 and 29 years old), while the others are approximately 35 years old. We finally present the dentists' remuneration contract in Panel A. As mentioned before, in the NHS GDPs can work either as salaried or self-employed. With the exception of 28 Polish recruits contracted with the salaried service, the dentists observed are predominately self-employed, of whom only 3 migrants and 1 non-migrant switched contracts during the sample period.

Next, the practice-specific characteristics reported in Panel B highlight the variation in geographic mobility and distribution between the migrant and non-migrant GDPs. By eliminating repeated claims on the same dentist and practice, we obtained a data set in which each observation corresponds to a unique dentist-practice combination or work episode. The table reports the average of the number of practices each GDP has worked for, and outlines the number and share of the GDPs by the number of practices resided. It is apparent that migrant GDPs generally switch practices less frequently than non-migrants: a smaller proportion of migrants (17.1%) than non-migrants (34.9%) have worked in more than one practice during the sample period. We also presents the average deprivation index of practices (ranging from 1 for most affluent to 7 for least affluent), and distinguish between different donor countries. Migrant GDPs on the whole, work in practices more deprived as compared to non-grants, while, among the migrants from the major donor countries, this is the case only with the Greek and Polish GDPs who migrated at an individual level. In particular, the Polish recruited GDPs, who are supposed to address the "unmet need in area of socio-economic deprivation" (NES, 2006), actually do not reside in practices as deprived as the other migrants. In the end, the number of practices where each group of GDPs have worked shown in the last row indicates a high concentration of migrant GDPs in certain practices: 240 work episodes of the migrants occurred in 139 practices, compared with 119 episodes in 108 practices for the non-migrants.

The last panel of Table 4.3 examines dentist performance in terms of treatment intensity and overall treatment provision. As to treatment intensity, we find that migrant and non-migrant GDPs claim very similar amounts of value for each CoT. Migrants show some variation in treatment intensity across donor countries: the German and Greek tend to provide patients with more treatment (by value), while the Irish and Polish, especially those directly recruited, provide less. Another issue of concern is to what extent migrant GDPs improve the access to NHS dental services. We measure the dentist overall treatment provision not only by the number of claims being made within each month, but also by the overall time the GDP deliver NHS dental services (measured by the sum of claim values paid each month). The average number of patients who have been treated by a particular dentist each month is also reported in the table. Statistics show that non-migrant GDPs, on average, provide much more NHS dental services than migrants, with 30% higher value and number of claims contributed and 30% more NHS patients treated per month. It is evident that there is quite a lot of variation across migrants from different donor countries. The Greek and non-recruited Polish GDPs perform the highest monthly value of NHS work (£5698.4 and £4924.7). The Irish, as a special group, tend to provide more treatment on more patients but with a low total treatment value than the others: they provide the most courses of treatment (120) on most patients (118) each month, but of lower value (£4872.9) than the Greek and non-recruited Polish. The German and recruited Polish fall behind with significantly less overall treatment provision, providing only 70 and 44 courses of treatment worth £3448.1 and £1823.4 on 69 and 43 patients on average each month respectively. We can see that the recruited Polish GDPs perform quite differently from the non-recruited. A likely explanation is the salaried contract scheme. As the recruited Polish are employed as salaried GDPs in those areas facing the most severe service problems and possibly the poorest oral health in Scotland, they might also be involved in NHS work in other sectors and, as a result, give less overall treatment provision in GDS. The NHS Workforce data of 2008 described in Section 4.1 suggest significant cross-commitments by salaried GDPs: as many as 293 of whom (82.3%) involve work in the Community Dental Service meantime.

Table 4.3: Individual characteristics and career patterns of migrant and non-migrant GDPs in the Scottish GDS.

	Non-migrant	Migrant					
	Scotland	All	Germany	Greece	Ireland	Poland	
						recruited	non-recruited
Panel A. Dentist Characteristics							
N (dentist)	83	199	18	24	26	28	55
Female	42	103	8	6	17	22	32
[%]	[50.60]	[51.76]	[44.44]	[25.00]	[65.38]	[78.57]	[58.18]
Mean age at entry	25.29	34.49	36.56	28.88	24.69	34.96	37.18
[SD]	[2.26]	[8.86]	[10.69]	[2.27]	[3.25]	[6.89]	[6.38]
Salaried	3	37	1	0	0	28	7
Self-employed	81	165	17	24	26	1	50
* switching contracts	1	3	0	0	0	1	2
Panel B. Practice Characteristics							
N (dentist-practice)	119	240	21	28	31	34	66
Mean number of practices resided by each dentist	1.43	1.21	1.17	1.17	1.19	1.21	1.20
[SD]	[0.67]	[0.50]	[0.38]	[0.38]	[0.49]	[0.50]	[0.56]
% Dentists working in 1 practice	65.06	82.91	83.33	83.33	84.62	82.14	85.45
% Dentists working in 2 practices	27.71	14.07	16.67	16.67	11.54	14.29	10.91
% Dentists working in 3 practices and more	7.22	3.01			3.85	3.57	3.64
Mean practice deprivation (1/7=least/most deprived)	3.83	4.04	3.81	4.07	3.77	3.82	3.98
[SD]	[1.76]	[1.39]	[1.50]	[1.70]	[1.33]	[1.17]	[1.25]
N (practice)	108	139	18	21	24	18	39
Panel C. Dentist performance							
N (claim)	212621	251314	16737	33474	41035	23011	87009
Mean claim value (constant SDR107 prices, £)	45.61	46.04	49.24	52.09	40.49	41.36	45.90
[SD]	[70.02]	[63.99]	[69.28]	[74.31]	[55.95]	[59.44]	[60.42]
N (dentist-month)	1796	2788	239	306	341	522	811
Mean number of claims per month	118.4	90.1	70.0	109.4	120.3	44.1	107.3
[SD]	[76.0]	[75.8]	[73.6]	[86.2]	[72.9]	[68.6]	[54.4]
Mean monthly values of claims (constant SDR107 prices , £)	5399.7	4150.5	3448.1	5698.4	4872.9	1823.4	4924.7
[SD]	[3451.7]	[3551.7]	[3280.6]	[4724.4]	[3064.7]	[2010.9]	[3226.3]
Mean number of patients treated per month	115.4	88.0	68.5	106.9	117.5	43.0	104.8
[SD]	[73.4]	[73.4]	[71.6]	[83.9]	[70.8]	[51.4]	[66.7]

4.4 DISCUSSION AND CONCLUSION

Scotland has seen a significant increase in the inflow of migrant dentists since 2006. However, without sufficient information detailing the workforce participation patterns among these migrant dentists, the implications for dental workforce planning are still ambiguous. We therefore, characterize the time trend of the retention for migrant dentists contracted with the Scottish GDS and identify factors that are important in their retention decisions using survival analysis techniques in next chapter.

Migrant GDPs demonstrate different career patterns compared with their non-migrant counterparts in their first 24 months after entry: they are more likely to work as salaried dentists and in deprived practices, and less likely to switch practices. In terms of dentist performance, we find they provide a very similar average amount of treatment for each CoT, but significant different amount of overall treatment each month. The overall treatment provision could arise from various circumstances. Migrant GDPs who have just arrived in a new country generally require a learning-by-doing type of process, which is likely to reduce efficiency. Also, they could simply have different practicing styles established in donor countries: for example, Irish GDPs seem to prefer treating more patients but with less work each visit, although this could also be a result of patient demand. Apart from these, there exists considerable uncertainty: GDPs may involve cross-commitments between different NHS sectors, and very commonly, they may devote some time and efforts towards private treatment provisions at the expense of their NHS work. The data we used provides little information to control these uncertainties, which hampers a further analysis of dentist performance in terms of overall treatment provision.

Nevertheless, the payment data record detailed information on each individual CoT, and warrant a further investigation of treatment patterns by migrant and non-migrant GDPs. To the extent that a dentist’ decision regarding how much treatment to offer depends on the characteristics of the patient treated, the dentist’s practice style, experience and training, etc, we compare individual treatments provided by the two groups of GDPs in Chapter 6, while adjusting for variations in both demand and supply side factors.

CHAPTER 5

MIGRANT DENTIST RETENTION IN THE SCOTTISH NATIONAL HEALTH SERVICE: A DISCRETE-TIME SURVIVAL ANALYSIS

5.1 INTRODUCTION

How migrant health professionals perform in the new country determines how well the international recruitment improves the health care provision in the host country. Using the MIDAS data described previously, we shall investigate the performance of EEA dentists working in the Scottish GDS in terms of retention and treatment provision. This chapter addresses the first aspect, and applies a discrete-time survival analysis to examine the retention of EEA dentists in the Scottish GDS.

As EEA nationals make an increasing contribution to the dental workforce in the Scottish NHS, a comprehensive understanding of retention patterns for these migrant dentists in the NHS is crucial to developing effective workforce planning. Questions of importance include: (1) how long and at what time trend do migrant professionals stay in the NHS? (2) how do retention patterns vary with personal characteristics? and (3) what factors influence the likelihood of an individual professional leaving the service? These questions, however, have rarely been addressed due to the limitations of available data. To our knowledge, only one work has attempted to examine some of these issues. Hann, Sibbald and Young (2008) examine the effect of the country of qualification on migrants' workforce participation in the NHS England using logistic regression modelling and find better long-term retention for migrant doctors from the Middle East, non-EEA Europe, Northern Africa and Asia compared with domestically qualified doctors. However, constrained by data limitations, their study is far from conclusive with only a few controls included, e.g. age, gender and medical specialty. To the extent that the decision with regard to labour supply is likely to depend on an aggregation of various information and influences, we employ detailed administrative data from the

Scottish dental system to gain a comprehensive understanding of the retention decisions of migrant dentists working in the Scottish GDS.

There is an extensive literature examining the retention decisions of teachers. A common feature of retention studies is that a proportion of subjects in the sample have work episodes still ongoing when data collection ends. These so-called *right-censored* subjects, with undetermined event time, provide important information, particularly about the probability that work episodes will last for relatively long periods of time. The methodology of survival analysis, which is originally developed for modelling human lifetimes in medical studies and later extended by economists and sociologists for modelling social transitions and engineers for modelling industrial product reliability (Willett and Singer, 1991), takes censoring into account. Willett and Singer (1991) introduce survival analysis methods into educational research using an example of teacher attrition and student dropout. Following their lead, teacher transfers and resignations are more adequately addressed. Factors that have been found to influence teacher career decisions include salary (Murnane and Olsen, 1989, 1990; Dolton and Van der Klaauw, 1995, 1999), the distance between the teaching school and high school or hometown (Boyd *et al.*, 2005), and working conditions such as school attributes, student race composition, and student achievement (Scafidi, Stinebrickner and Sjoquist, 2003; Hanushek, Kain and Rivkin 2003; Boyd *et al.*, 2005). In particular, the work by Boyd *et al.* (2005) comprehensively examines these factors using a discrete-time competing-risk model incorporating unobserved heterogeneity (mixed-logistic regression) and suggests that interactions between teacher qualifications and student achievement, unobserved heterogeneity, and the geography of prior home and job play important roles in explaining variations in retention rates among New York City elementary schools.

Studies related to the health sector, on the other hand, are very limited. The few contributions we are aware of focused on doctors working in the USA. Singer *et al.* (1998) apply discrete-time survival analysis to explore effects of physician and centre characteristics on the hazard of a primary care physician leaving the Community Health centre. Pathman *et al.* (2004) use the Cox proportional hazard modelling technique to compare retention durations for physicians in rural health professional shortage areas (HPSAs) and non-HPSAs. After accounting for physician characteristics, community characteristics, and practice and job characteristics, no significant difference between the two cohorts has been found. Using the same method, Ries *et al.* (2009) evaluate the effects of the Academic Medicine's faculty development program on the retention of junior faculty at the University of California, San Diego.

In this paper, we make use of administrative data collected for authorising payments for NHS dental treatment in Scotland to gain a better understanding of retention decisions of migrant dentists and influences on these. These data are far more detailed than what has previously been analysed in health professional retention research. They provide information on the attributes of every EEA dentist in contract with the Scottish GDS during the period of 12/1996 – 09/2008, the practice where they practiced, and the value for the treatment they delivered at various time points during their work episodes (dentist overall treatment provision). More importantly, the matched patient-practitioner longitudinal structure of the data permits direct observation of the patient population being treated. Discrete-time proportional hazards modelling is applied to characterize the time trend of retention for migrant dentists in the Scottish NHS and identify factors associated with the likelihood of a dentist leaving the service. The econometric methodology assesses the importance of four dimensions of variables in the underlying utility function that governs each dentist's stay-or-leave decision while controlling for random unobserved heterogeneity.

The remainder of this chapter is organised as follows. The next section introduces full details of the two survival analysis methods that are used in our study. Section 5.3 lays out the process we used to convert the data set to accommodate discrete-time survival analysis techniques from the individual level claim-based payment data we have. This section also describes the variables that are likely to affect dentists' retention decisions. Estimation results are presented in Section 5.4. The last section discusses the results and concludes the chapter.

5.2 DISCRETE-TIME SURVIVAL ANALYSIS METHODOLOGY

This study makes use of survival analysis techniques where dentist departure from the GDS is the event of interest. Given the MIDAS data which records payment dates for claims at a monthly scale, we can measure dentist retention to the nearest month and therefore apply discrete-time survival analysis methods which model discrete hazard of dentists leaving the service.

The standard way of estimating discrete-time hazard models is to construct a panel data set with a separate record for each time period the dentist is at risk of event occurrence, i.e. eligible to experience the target event; in our case, that is from the baseline month when he/she entered the GDS until the month of exit or the closing month of the study (censored). Each record consists of an indicator variable for duration time, a binary response variable for event occurrence, and a set of covariates that are likely to influence dentists' retention behaviour. The duration time is converted from calendar time by indexing calendar months using t=1,…, T for each of the half-open monthly interval [t-1, t), where we set t=0 at the baseline month. The process we use to create this panel data set and covariates will be discussed in detail in Section 5.3.

Risks of the target event occurring are generally described and modelled using *hazard* and *survival* in survival analysis. The hazard function, λ_{it}, is defined as the conditional probability that dentist i will depart from the GDS in a time interval (month) t given that he/she does not depart in any earlier period:

$$\lambda_{it} = \Pr\{T_i = t | T_i \geq t\}, \quad (5.1)$$

where T_i denotes the number of months elapsed between dentist i entering and departing. Survival function S_{it} is defined as the probability that dentist i will "survive", i.e. will not depart beyond the time interval t:

$$S_{it} = \Pr\{T_i > t\}. \quad (5.2)$$

For this to happen, the dentist must not depart in all previous periods. Thus, the hazard function specifies the risk of dentist departure specific to each particular time period, while the survival function specifies the cumulative risk of non-departure across the current and previous periods.

Two analytical methods are frequently used for estimating hazard and survival functions: the Kaplan-Meier (KM) survival analysis and hazard regression modelling. The non-parametric KM (or product-limit) method (Kaplan and Meier, 1958) pools together dentists who are not distinguished by observable covariates, and estimates the hazard and survival for homogeneous dentists, denoted as $\hat{\lambda}_t$ and $\hat{S}_t$ with the subscript i dropped. This method is widely used as a basic but important tool for preliminary analyses to provide straightforward illustrations and useful summaries of duration data. Advanced regression modelling techniques, on the other hand, allow for individual heterogeneity by covariates, time-variation and covariate-dependence in the hazard probability. In particular, the discrete-time framework, which essentially estimates a pooled binary response model of whether or not the dentist finishes his/her work episode within each calendar month after entry, allows us to not only explore the relationship between hazard and various predictors, but also to determine whether the effects of predictors vary with time.

5.2.1 Kaplan-Meier survival analysis

Let n_t be the number of dentists that entered the interval *t* and who are at risk during that time period, d_t be the number that departed from the GDS during the interval *t*, and c_t be the number that were censored at the end of the interval. Dentists at risk in the time interval *t* will drop out of the risk pool once the target event or censoring occurs; otherwise, they will enter the risk pool in the future interval. Thus, the relationship between these three numbers can be expressed as:

$$n_t = n_{t+1} + d_t + c_t = \sum_{j \geq t}(d_j + c_j). \tag{5.3}$$

A natural estimator for KM hazard, $\hat{\lambda}_t$, is the fraction of those dentists entering the interval that depart during the interval:

$$\hat{\lambda}_t = d_t / n_t. \tag{5.4}$$

The corresponding survival estimate, $\hat{S}_t$, can be estimated by multiplying the survival probability for the pervious time period by one minus the hazard probability for that period, or multiplying probabilities of dentist non-departure across the current and all previous periods together:

$$\hat{S}_t = \hat{S}_{t-1}(1 - \hat{\lambda}_t) = \prod_{j \leq t}(1 - \hat{\lambda}_j). \tag{5.5}$$

KM estimates are also the maximum likelihood estimates of hazard and survival functions for a randomly selected dentist (Singer and Willett, 1993). These estimates take censoring into account by setting the conditional probability of dentist departure at a particular time period equal to the frequency of observed departures at that period. The fundamental assumption for doing this is that the censoring mechanism operates independently of the event occurrence and the risk of event occurrence, or is what is termed *non-informative* (Singer and Willett, 2003). Therefore, dentists remaining in the study after the censoring time can be assumed to have the same retention perspective as those who would have remained in the study had the sample period been long enough to allow all people to experience the target event:

$$\hat{S}_t = \prod_{j \le t}(1 - \hat{\lambda}_j) = \prod_{j \le t}(n_j - d_j)/n_j = \prod_{j \le t}(n_{j+1} + c_j)/n_j. \quad (5.6)$$

Were there no censoring occurring, the survival estimate would simply equal the number "at risk" by the end of interval divided by the number of total observations in the study:

$$\hat{S}_t = \prod_{j \le t}(n_{j+1}/n_j) = n_{t+1}/n_1. \quad (5.7)$$

Note that if the censoring mechanism is informative, i.e. subjects are lost to follow up because they have experienced the event or are likely to do so in the near future, survival analysis will be biased just as other traditional statistics methods. This is because there is no way of knowing whether they drop out from the study at random as assumed, or due to reasons that relate to the (unknown) event occurrence.

By plotting the KM survival estimates against the duration time, we obtain the KM survival curve which is a useful graphical method in the survival analysis. We can construct a KM survival curve for the whole population of dentists to describe and display the trend of dentist retention in the GDS over time. Median survival time, another important statistic in survival analysis, can be directly indicated in the KM survival curve as the time at which the survival probability is 50%. Mean survival time is inappropriate in the presence of censoring dentists with unknown length of stay.

We can also construct separate KM survival curves for grouped dentists to determine univariate effects of categorical variables. The Log-rank test (Mantel, 1966) can be used as a robust test for the differences in survival probabilities across subgroups. However, this method does not allow us to quantify the effect size. Furthermore, variations we observe are likely to confound effects of other factors because dentist decisions as to whether to stay or leave the GDS are generally influenced by various risk factors. For example, if dentists from different countries have different demographic distribution (e.g. age at entry), we might confound country effects with those omitted demographic effects. Despite these shortcomings, the KM graphical method is very popular for a preliminary analysis and also a specification check for the hazard regression model building.

5.2.2 Regression modelling: proportional hazards specifications

The regression modelling technique for survival analysis allows us to simultaneously quantify the effects of multiple risk factors behind dentists' departure decisions. The most commonly used model is the *proportional hazards*, or PH specification. In this, the hazard function depends on a baseline hazard function $\lambda_0(t)$ and a vector of covariates X_{it} with unknown coefficients β:

$$\lambda_{it} = \lambda_0(t)\Phi(X_{it}, \beta), \tag{5.8}$$

where $\Phi(X_{it}, \beta)$ is often assumed as $\exp(X_{it}\beta)$ so that $\partial ln\lambda_{it}/\partial X_{it} = \beta$. Thus, coefficients β can be interpreted as the time-constant proportional effect of covariates X_{it}, which describes the departure from the baseline hazard $\lambda_0(t)$ shared by the all study subjects. A covariate with a positive/negative coefficient β, and therefore a $\exp\beta$ greater/smaller than 1, is positively/negatively correlated with the conditional probability of dentist departure and negatively/positively correlated with the retention duration.

Existing literature suggests it is important to account for unobserved heterogeneity in hazard modelling, especially in case that controls for effects of covariates are incomplete or unobservable variables are important. Omitted heterogeneity typically distorts the duration dependence downward as a result of the "weeding out" of individuals with higher hazard (unobserved random effect) (Lancaster, 1979; Kiefer, 1988; Van den Berg, 2001). The omitted heterogeneity also induces attenuation biases of the covariates, X_{it}, or the dependence between covariate effects and duration, t, which will give misleading inferences regarding the covariate effects of the regressors (Lancaster, 1985; Sharma, 1987; Kiefer, 1988). Lancaster (1979) proposes a mixed proportional hazards (MPH) model with a time-constant random component to capture the variance of unobserved heterogeneity (*frailty*):

$$\lambda_{it} = \lambda_0(t)\exp(X_{it}\beta)v_i = \lambda_0(t)\exp(X_{it}\beta + \varepsilon_i), \tag{5.9}$$

where v_i is a random variable with mean one and finite variance, and $\varepsilon_i \equiv \ln(v_i)$ is the i.i.d. error term.

A variety of specifications have been suggested for estimating the proportional hazards model. The Cox semi-parametric specification proposed in 1972 (Cox, 1972) estimates coefficients β using the partial-likelihood approach without specifying the distribution of the baseline hazard. The baseline hazard rate can be retrieved with the typical method used being a noisy step function over-fitted to the observed data (Royston and Parmar, 2002; Jones and Branton, 2005).

In fact, accurate inference and out-of-sample prediction of the duration dependency is generally of interest to policy makers. The parametric specification is therefore more often used, which integrates a baseline hazard function following a specific statistical distribution (e.g. exponential, Weibull, Gompertz, log-normal, log-logistic, and generalized gamma distribution). However, the estimation of coefficient effects will be biased if the shape of duration dependency is mis-specified (Light and Omori, 2004).

Royston and Parmar (2002) propose a flexible parametric alternative of the Cox specification. This new approach provides a middle ground: it uses spline functions (i.e. piecewise polynomial functions) to flexibly model the duration dependency, and allows for explicit, although not very easy-to-interpret, characterization of the duration dependency. Yet, further extensions are required, including frailty, competing risks, etc (Lambert and Royston, 2009).

A far more commonly used approach is the discrete-time specification, which is fully developed and better understood by economists and social scientists. Given the equivalence between the standard maximum likelihood estimator for the discrete duration data, proportional hazard model, and traditional binary response models (Kiefer, 1988; Doskum and Gasko, 1990; Sueyoshi, 1995), the discrete hazard function can be modelled using sequential binary linked models such as the complementary log-log (cloglog) and logit model:

$$\begin{aligned}&\text{cloglog}(\lambda_{it}) = \log(-\log(1-\lambda_{it})) = \log\lambda_0(t) + X_{it}\beta + \varepsilon_i,\\ &or \quad \lambda_{it} = 1 - \exp[-\exp(\log\lambda_0(t) + X_{it}\beta + \varepsilon_i)]\,; \quad and\end{aligned} \tag{5.10}$$

$$\begin{aligned}&\text{logit}(\lambda_{it}) = \log[\lambda_{it}/(1-\lambda_{it})] = \log[\lambda_0/(1-\lambda_0)] + X_{it}\beta + \varepsilon_i,\\ &or \quad \lambda_{it} = 1/[1+\exp(-\log[\lambda_0/(1-\lambda_0)] - X_{it}\beta - \varepsilon_i)]; \quad and\end{aligned} \tag{5.11}$$

where $\log\lambda_0(t)$ and $\log[\lambda_0/(1-\lambda_0)]$ are log of the baseline hazard and odds functions requiring estimation, and ε_i is a dentist-specific random effects following a particular distribution.

The former corresponds to the proportional hazards model, while the latter corresponds to the proportional odds model. The proportional hazards (odds) model is now essentially a multiple linear regression of the transformed discrete hazards on the baseline hazard (odds) function, which is absorbed into an intercept term that varies with time, and covariates that are likely to affect the hazard (odds) rate. The proportionality assumption can be relaxed simply by including interaction terms between covariates and (log) time.

The distribution of the baseline hazard function can be modelled in many ways: piecewise functions, standard transformations (e.g. logs, polynomials, etc), and smoothing functions (e.g. splines, kernel, local polynomial regression, etc) (Jones and Branton, 2005). The piecewise function that includes a dummy variable for each interval allows for a fully flexible estimation of the duration dependency, and is therefore far more widely used in the literature. One problem with this method is the potential computational problems imposed when data have either small sample size or a large number of discrete time periods, as in our case, or when too few events or subjects can be observed at some time periods (Singer and Willett, 2003). In these cases, the other two methods may have some advantages in arriving at accurate estimates. Among smoothing methods, the local polynomial regression is particularly recommended for hazard modelling on discrete duration data (Wang, 2005), and a common option is the local linear regression, which is also called the locally weighted scatterplot smoothing (LOWESS). This method flexibly models the duration dependency using the smoothed values obtained by fitting weighted least square polynomial regressions locally to each bandwidth specified. By doing this, the model captures the most influential part of the variation in the data. The only problem is that it does not give a distribution function of the hazard, making it difficult in our case to interpret and forecast the time trend of dentist retention.

The distribution of ε_i is typically assumed as following either a Normal (Gaussian) distribution or a Gamma distribution in the discrete-time framework. Although Heckman and Singer (1984) find the misspecification of heterogeneity distribution can seriously bias regression parameter estimates and duration dependence in the case of Weibull models, most work in the literature suggests that estimates in general are not very sensitive to the specification of the mixing distribution as long as the specification of the baseline hazard is sufficiently flexible (Kiefer, 1988; Addison and Portugal, 1998; Nicoletti and Rondinelli, 2009).

5.3 DATA DESCRIPTION

The data used in this analysis come from the MIDAS, a large-scale individual-level claim-based database that covers all NHS treatment delivered and paid in the Scottish GDS over the last ten years. Dentists in practice are required to submit a claim for each single course of treatment delivered to a patient, detailing the dentist, patient, practice and treatments. Our information on the spell of work episodes is therefore precise and rich compared with existing literature in two aspects. First, we have the exact number of months of participation rather than approximate years, since payments are transacted monthly. Second, the matched (dentist-patient) longitudinal data not only provide information on the standard controls such as dentist personal characteristics, overall treatment provision and practice characteristics, but also direct observations of patient composition. The latter two types of variables, in particular, comprehensively capture dentists' working conditions.

For the purpose of our analyses we obtained a full sample from the MIDAS database covering all claims submitted by the 269 migrant dentists in contract to the GDS during the period of 12/1996 – 09/2008.

5.3.1 Construction of the panel data for survival analysis

As discussed in the previous section, this individual level claim-based payment data need to be converted into a monthly panel so as to accommodate discrete-time survival analysis techniques. The panel data approach not only leads to easy fitting of flexible hazard functions but also facilitates introduction of time-varying covariates that are likely to influence dentists' decisions to leave (Wooldridge, 2006).

As dentists may provide services in multiple practices within the same month, and each practice's resident dentists have a unique list number to process NHS transactions, we configure the following two versions of the panel data set:

Version 1: List number–month panel

The first version was generated by aggregating claims within dentists' list number and calendar month, so that we have a single observation for each list number-month match. Within each match, we not only retained variables provided in MIDAS such as calendar time, dentist ID, dentist demographic characteristics (e.g. gender, age at first treatment, country from which the VT number was applied, etc.), list number, and practice characteristics (e.g. postcode, practice deprivation, health board ID, etc.), but also generated a new variable for the monthly overall treatment fees. Of the migrant practitioners in the sample, 77 out of 269 (29%) have undertaken NHS work in multiple practices, with 55 of them having worked in different practices in the same month while 24 took short or long breaks before joining the new practice.

Version 2: Dentist–month panel

The second version of the panel data set is where we only keep one observation for each single calendar month the dentist has received payments for NHS treatment. List numbers overlapping on the same dentist and same month are pooled together, and we retain only either the value of a variable for the dominate list number on which the dentist claimed the highest fees during the month (e.g. remuneration structure, practice characteristics), or the aggregated value.

The two versions of data set define work episodes in different ways and capture different dentist retention duration: version one of the data set defines work episodes by list number and captures elapsed retention in each practice, while version two pools separate list numbers at intervals shorter than 12 months[12] together into one work episode and captures completed retention in the GDS. Although the first version contains more work episodes for regression analysis, we prefer the second version because the variable of interest is the completed retention duration.

A central issue is how to define a dentist's entry and exit properly using the claim data in which no accurate dates are provided – while the MIDAS records the resignation date of dentists' list number, we find that dentists in the sample usually do not immediately stop receiving payments after resigning their list numbers. Instead, it is possible to determine whether a practitioner is active or not in the GDS using the new generated monthly payment panel. We assume that a dentist enters the service since his/her first monthly payment comes under observation. Once entered, the dentist can be observed in each single calendar month unless he/she takes a break and receives no

[12] In the definition of exit laid out in the following paragraph, we view payment gaps less that 12 months as intermediate breaks rather than completion of work episodes.

payments, or exits from the service. We generated a variable to measure the number of months elapsed until the next monthly payment is observed for the dentist and find that 117 out of 269 (43%) dentists were missing in one or more intermediate months and subsequently returned later. The majority (269/274) of these payment gaps were less than 12 months, with only 5 exceptions ranging between 13 and 42 months. To allow for intermediate breaks within work episodes, we assume a dentist departs if he/she has no subsequent payment recorded over the next 12 months. By this definition, payment gaps shorter than 12 months are considered as temporary interruptions, not resulting in the exit from the analysis risk pool.

The panel data set for discrete-time survival analysis requires a separate record for each time period when the dentist is "at risk" rather than when the dentist has payment observed. The process by which we converted the payment panel into the survival-time panel involves the following three steps. First, we compress the monthly payment panel into a dentist-level data set which include data on dentist ID, the first month and final month the dentist receive payment in the sample period, dummy variable for event occurrence and a set of time-constant covariates for the dentist. Second, the dentist-level data set is converted into a survival-time dataset and expanded into a monthly panel using the STATA command "stset" and "stsplit" (STATA9, 2005). Finally, we include time-varying covariates by merging the new generated dataset with the payment panel dataset we first generated.

The "exit" defined here is a dentist's first episode of departure from the GDS, which is the event of interest to our analysis. Re-entry records that follow a gap longer than 12 months are defined as the dentist's subsequent episode and excluded from our analysis. An alternative method is to treat the period after re-entry as a separate episode, which is unlikely to change our estimation results given the small number of records (26, 0.5% of the initial sample) observed for dentists' subsequent work episodes. Total duration of dentists' participation in the NHS workforce cannot be estimated since there is no way of knowing whether a dentist that is observed to terminate the final work episode exits from the GDS permanently or is just on a break, waiting for new work episode.

To illustrate another important implication of this definition, we plot the observed retention time for each dentist against the time they enter the GDS in Figure 5.1. The dots represent those dentists who had an event, i.e. departed from the GDS, and the triangles represent dentists who were censored. As we can see, dentists who were observed within the last year of the sample period (09/2007-09/2008) are considered to have ongoing episodes and censored event time.

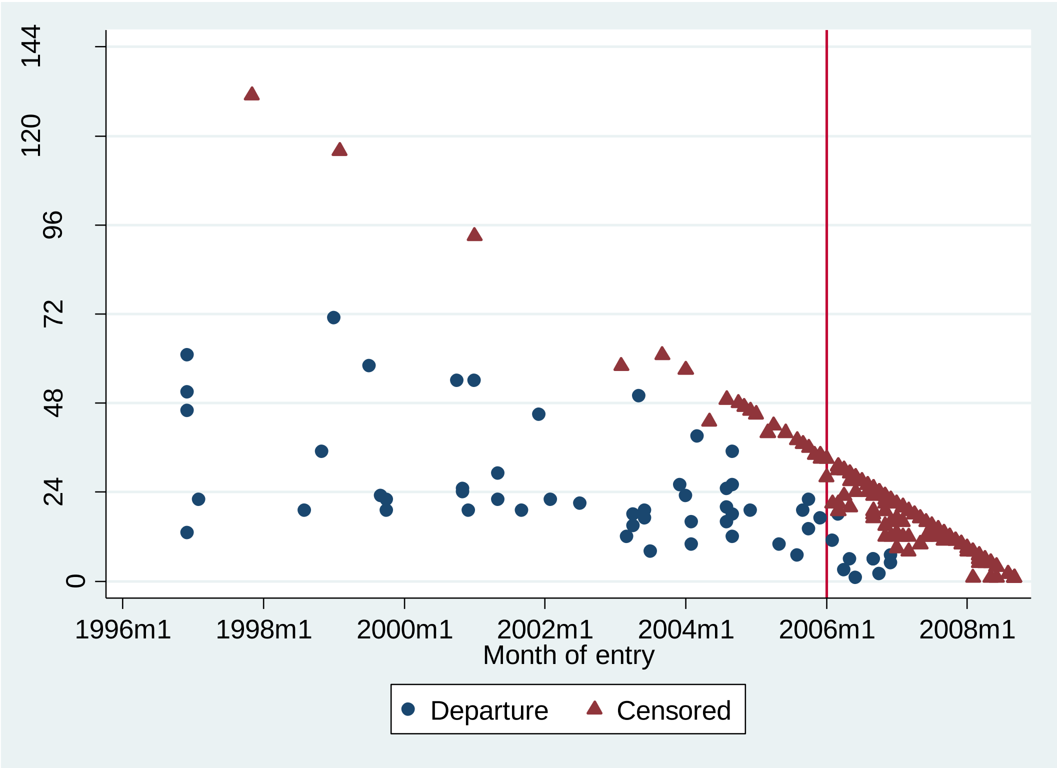


Figure 5.1: Plots of the observed tenure by month of entry for the migrant dentists active in the Scottish GDS between 1996 and 2008 (n=269).

Figure 5.1 also indicates that the migrant dentists working in the Scottish GDS are predominantly recent entrants who arrived after 2006 (199, 74%), for whom the study period (12/1996 – 09/2008) is insufficient to observe a complete work episode. It is important to note that although censored work episodes can be included in the survival analysis, the length of study period is still very important. The design of the study must allow for enough complete work episodes to be observed, a condition necessary to perform robust empirical analysis (Clark *et al.*, 2003). Thus, we restrict our attention to the dentists who started practising in the GDS during the period of 1996-2005.

The refined sample includes 70 dentists who had experienced 49 complete work episodes and accumulated 2415 monthly observations by the end of data collection. The comparison between the original sample (arrival cohorts 1996-2008) and refined sample (arrival cohorts 1996-2005) in terms of the number of events and the length of study period can be found in Table 5.1. We report three indicators for the length of study period: the median of observation time (i.e. the median tenure of all dentists), the median of censoring time (i.e. the median tenure among those dentists who have not yet left the service), and the reverse Kaplan-Meier estimator calculated using the KM estimate of the survival function with the event indicator reversed such that the outcome of interest becomes censored (i.e. the tenure that potentially would have been obtained had that dentist not left the service) (Schemper and Smith, 1996). While the former two may underestimate the length of the study period, the third one offers a more robust measure (Clark *et al.*, 2003). Although the refined sample contains only 70 dentists relative to 269 in the original sample, these dentists had 49 complete work episodes observed in the study period, only 10 less than the original sample. Furthermore, the sample refinement doubles the reverse KM estimators from 23 months to 49 months. We tried different cut-off years such as 2005 and 2007, but based on these statistics they either lose too much information or are overly influenced by the censoring.

Table 5.1: Overview of the original and refined sample.

Arrival cohorts	Original sample 1996-2008	Refined sample 1996-2005
Sample size		
N(dentist)	269	70
N(dentist-month)	5572	2415
Number of complete episodes	59	49
Entry period	12/1996 – 09/2008	12/1996 – 12/2005
Closing date	09/2008	
Length of study period, months		
Median of observation time [range]	19 [1,131]	26 [7, 131]
Median of censoring time [range]	18 [1,131]	45 [33,131]
Reverse KM estimator	23	49

5.3.2 Factors behind dentists' retention decisions

The NHS payment data provides information on a rich set of factors that are likely to affect dentists' decision whether or not to continue practising in the GDS. We summarise these as follows (see Table 5.2 for descriptive statistics).

- Dentist personal characteristics

Dentist demographic attributes available in the data include gender, age-at-entry[13] and the country from which the dentist applied. Dentist gender and age-at-entry both control for the likely presence of individual heterogeneity in preferences and moving costs among dentists. Country indicator variables capture variations in dentists' length of stay across donor countries; health professionals from different countries are expected to have different likelihoods of leaving arising from either different alternative wages if returning home, or different labour market ability as the level of international recognition for the health service delivery and training system differs across countries. To ensure enough subjects exist within each country group, we pooled dentists from the smaller donor countries outside of the top four donor countries (e.g. Spain, Ireland, Greece and Sweden) into a large group denoted as "Other". Variables indicating the year when the dentist provided the first treatment in the GDS are also included to

[13] We include the age-at-entry identified as the age at first treatment rather than age at treatment due to the high correlation between experience and age at treatment.

examine whether there is any trend by arrival cohort in the retention behaviour. Similarly, the year 1996-2002 were grouped together given only a handful of dentists joined each year before 2003.

- Practice characteristics

Practices are characterized in terms of the deprivation category scale from 1 (most affluent) to 7 (least affluent) based on practice postcode and the health board in which the practice resides. Practice deprivation indicators help to capture spatial variations in living costs and amenities, and also the different patient types by proxy for patients' socioeconomic characteristics. The scales lower than 4 and higher than 5 were merged into two new categories respectively as most migrant dentists concentrated in practices with deprivation categories 4 and 5. Similarly, the 13 health boards were merged into 3 by pooling those contracting less than 8 sample dentists into a single artificial "health board".

- Patient composition

The matched (patient and dentist) MIDAS data permit accurate descriptions of patient composition. Although it does not capture all potential patient attributes, we include three elements of the patient population: percent exempt patients, percent male and average patient age at treatment. Patients with different demographic characteristics are expected to have different dental conditions and treatment requirement. Our work on treatment intensity in Chapter 6 finds middle aged and male patients receive more intensive treatment. The exempt status of patients could also give rise to different economic incentives for dentists. Given that the effect of time-varying variables cannot be separated accurately from the possible duration dependence unless the time paths of variables vary considerably across individuals (Kiefer, 1988), we calculated these variables over all patients being treated over the whole course of the work episode.

Exploring how practice characteristics and patient composition influence dentists' hazard of leaving, we are able to identify the practices that experience difficulties in retaining international recruits. However, practice characteristics and patient composition are likely to be associated with the total value of the treatment provided by dentists, which provides dentists with another important incentive to stay or leave. In this case, the failure to account for variations in overall treatment provision will confound the effects of interest with those of overall treatment provision. Thus, our final controls concern dentists' overall treatment provision.

- Dentist overall treatment provision

Under the NHS dentistry payment system where GDPs are recompensed for time, the overall treatment fees received by dentists within each month (in constant SDR107 prices) provide a direct indicator of dentists' overall treatment provision. We assume that dentists' overall treatment provision is exogenous and captures the demand side shift. Dentists whose patients require lower value of treatment are more likely to leave the service. The identification of overall treatment provision is of importance. In practice, time-varying variables are usually simplified into a summation, so we first calculate the average of monthly treatment fees received by each dentist over the whole course of the work episode as a summation measure of overall treatment provision. However, allowing for variables to vary over time in estimation has turned out to be very important in empirical work (Lancaster, 1979; Atkinson and Micklewright, 1985). We thus make use of the rich information available in the monthly payment data and account for the time paths of individual circumstances. However, the inference can be difficult as a result of state dependence or rate dependence, i.e. predictors are reversely affected by an individual's event status or his hazard (Singer and Willett, 2003). In our context, dentists may reduce labour supply in the month they leave or are going to leave. To solve this problem, we calculate the average of monthly fees for the treatment that dentists have provided during the past six practice months[14] as dentists' departure decision is less likely to affect their labour supply several months earlier. This method links prior predictor status with current outcome status by assuming dentists adjust their risk of leaving according to the amount of treatment fees they received in previous months, which seems fairly plausible. Considering the time trend of overall treatment provision, treatment fees are normalised by the average of all the dentists who have practiced in the GDS for the same number of months to capture dentists' relative overall treatment provision compared to the dentists with same experience.

Table 5.2: Descriptive statistics.

Variable	Obs	N/Mean	%/SD	min	max
A. Dentist characteristics					
Age-at-entry	70	30.46	7.63	22	58
Gender (male=1)	70	32	46%	0	1
Country					
Greece	70	9	13%	0	1
Ireland	70	11	16%	0	1
Spain	70	16	23%	0	1
Sweden	70	9	13%	0	1
Other	70	25	36%	0	1
Year of entry					
1996-2002	70	26	37%	0	1
2003	70	10	14%	0	1
2004	70	18	26%	0	1
2005	70	16	23%	0	1
B. Practice characteristics					
Practice deprivation category (1: affluent 7: deprived)					
depcat_1-3	70	16	23%	0	1
depcat _4	70	27	39%	0	1
depcat _5	70	18	26%	0	1
depcat _6,7	70	9	13%	0	1
Anonymous Health board ID					
caid _8	70	26	37%	0	1
caid _10	70	13	19%	0	1
others	70	31	44%	0	1
C. Patient composition					
%Male patients	70	0.44	0.05	0.24	0.56
Average patient age (Page)	70	40.43	5.93	18.98	53.51

[14] Monthly treatment fees were averaged over the period of past six practice months rather than calendar months to avoid a loss of information, because there are ten dentists in the sample leaving the service right after a six-month break or even longer with no treatment provided.

%Exempt patients	70	0.32	0.13	0.02	0.72
D. Dentist overall treatment provision					
Average monthly treatment fees over the whole career					
meanfeesperm	2415	42.35	25.31	0.45	107.32
Normalised average monthly treatment fees in past 6 months					
nfeesperm6	1972	0.00	33.31	-54.31	166.25

5.4 ESTIMATION RESULTS

5.4.1 Overview

We present our statistical results in two parts. The well-known non-parametric KM method was first applied as a preliminary analysis. KM hazard and survival functions were estimated for the total sample of dentists to provide a straightforward illustration of the time trend of retention for migrant dentists contracted with the Scottish GDS. Univariate effects of categorical variables (e.g. country, year of entry, deprivation category of practice and health board) were also evaluated using the KM method. By doing this, we can assess the equality of KM survival estimates across categories and, if appropriate, combine similar categories together for a simpler categorical variable to be included in the subsequent regression models.

In the second part, we characterize the duration dependency of the hazard of dentists leaving the service and identify factors affecting the hazard rate using a proportional hazard modelling approach. Since dentist participation is defined by monthly treatment fees, we adopt the discrete-time specification estimating a complementary log-log linked binary model of whether or not the dentist finishes the work episode at each month after entry. Duration dependency is modelled using both the flexible LOWESS function and a quadratic function of logarithmic time. We report estimation results of the quadratic specification in the final model to explicitly characterize the duration dependency. A proportional odds model and the flexible parameter specification were also estimated as robustness checks. Finally, unobserved heterogeneity is taken into account by incorporating an individual-specific random error component following different distributions (e.g. Gaussian and Gamma distributions).

5.4.2 Kaplan-Meier estimation

Description of retention data

To illustrate the calculation process for the KM estimates, we present the distribution of the retention duration for the 70 migrant dentists who joined the Scottish GDS between 1996 and 2005 by each year of the career in Table 5.3. The table summarizes the number of practitioners that are at risk at the beginning of the year (column 2), the number that departed from the GDS during the year (column 3), the number that were censored by the end of the year (column 4), and the KM estimates of survival and hazard functions (column 5 and 6).

Table 5.3: Kaplan-Meier survival analysis of retention for migrant dentists in the Scottish GDS between 1996 and 2008.

	Number who…				
Year since entry t	Were at risk (active) at the beginning of the year n_t	Depart during the year d_t	Were censored at the end of the year c_t	Survival function $\hat{S}_t$	Hazard function $\hat{\lambda}_t$
1	70	4	0	0.94 [0.03]	0.06 [0.03]
2	66	27	0	0.56 [0.06]	0.41 [0.08]
3	39	8	3	0.44 [0.06]	0.21 [0.07]
4	28	3	10	0.40 [0.06]	0.11 [0.06]
5	15	5	4	0.26 [0.06]	0.33 [0.15]
6+	6	2	4	0.18 [0.07]	0.33 [0.24]

Standard errors are in square brackets.

As shown in Table 5.3, dentist departure peaked in the 2nd year following entry: almost two fifths of dentists (27) left the service during this interval. Censoring starts to influence the outcome from the 3rd year. Of the 39 dentists who worked in the service for 3 continuous years, 8 finished their work episodes and 3 were censored by the end of the year. This left 28 entering their 4th year, and for these dentists censoring occurs more commonly, with 18 censored and only 10 leaving the service by the end of sample period. Thus, we can estimate the hazard rate in year 3 and 4 as 8/39 = 0.21 and 3/28 = 0.11 and the corresponding survival rate as $0.56 \times (1-0.21) = 0.44$ and $0.44 \times (1-0.11) = 0.40$ regardless of censoring. The survival rate for the 2nd year can be estimated as 39/70 = 0.56 directly since no censoring has occurred then. However, these figures are not precise as the standard errors for the hazard estimates and survival estimates are large. Standard errors for years 5 and 6+, in particular, are not reliable because the number of dentists at risk in year 5 drops below 20 (Singer and Willett, 2003). In what follows, we restrict the discussion of KM estimates to the initial 48 months after entry.

Actuarial KM survival and hazard curves for the pooled dentists were constructed at monthly intervals in order to examine the pattern of non-UK qualified dentists' retention in the GDS in greater detail. Figure 5.2 displays the estimated proportion of dentists who departed from the service and dentists who were practising in the GDS by each month, starting from the month of entry until the month of departure or the end of the sample period (September 2008). As shown in the figure, the small sample size brings about large fluctuations in the hazard estimates. Overall, we see an inverse U-shaped time trend pertaining to the hazard of leaving: it increases up to the end of the second year, peaking in months 19 through 22, and then declining, followed by an upward tail in later periods. Correspondingly, the survival estimates drop sharply nearing the end of the second year. The median tenure (where the survival estimate is 0.5) for the non-UK qualified dentists is indicated as 26 months, suggesting that half of the non-UK qualified dentists under study have already departed from the GDS by the 26th month following entry. All these suggest there is a high turnover of migrant dentists in the GDS, which is likely to be a concern for policy makers in the context of poor access of NHS dental services.

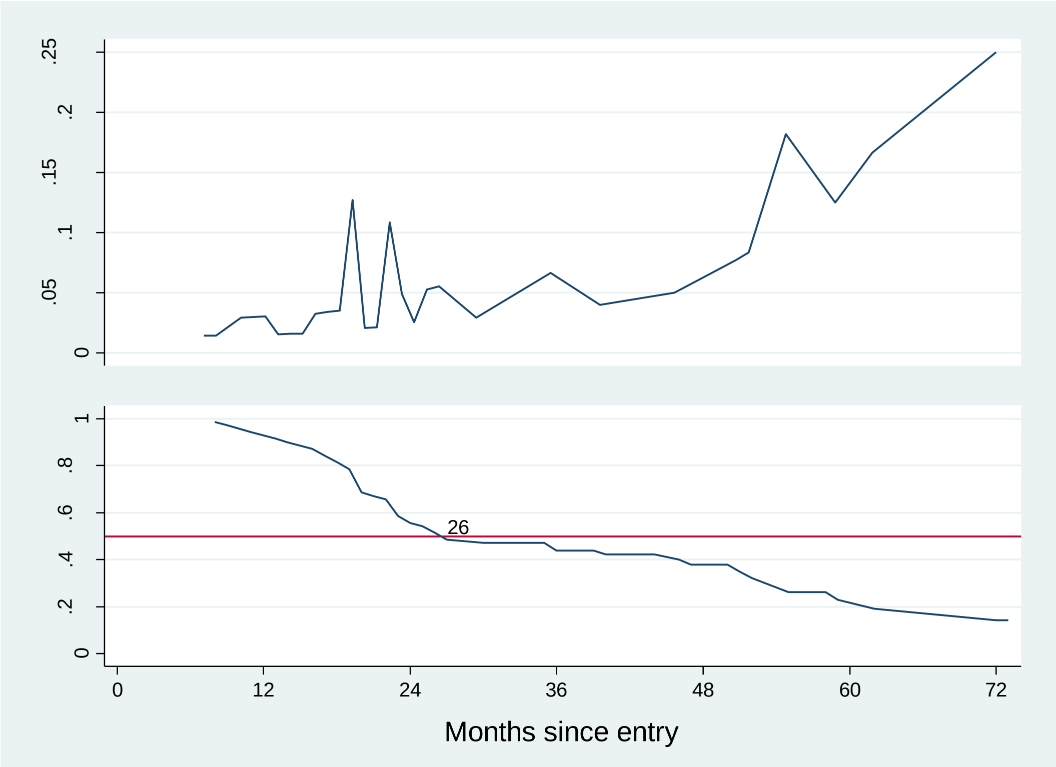


Figure 5.2: Kaplan-Meier survival analysis of retention of retention for migrant dentists in the Scottish GDS between 1996 and 2008.

Univariate analysis

Figures 5.3-5.6 present the results of the univariate analysis of categorical variables (e.g. country, year of entry, deprivation category of the practice and health board) using the non-parametric KM method. A separate KM survival curve was constructed for each subgroup and log-rank tests were employed to examine the equality of the survival functions. The median tenure for each subgroup is indicated in the figures as the time when the survival estimate equals 0.5. Overall, we find significant effects for all the categorical variables on dentists' retention behaviour when controlling no other effects: log-rank tests rejected the hypothesis that the survival functions are the same across subgroups. Furthermore, effects of these variables seem to be duration-dependent: the differences of survival estimates, even the rank, among subgroups change over dentists' career. Therefore our data may not meet the proportionality assumption.

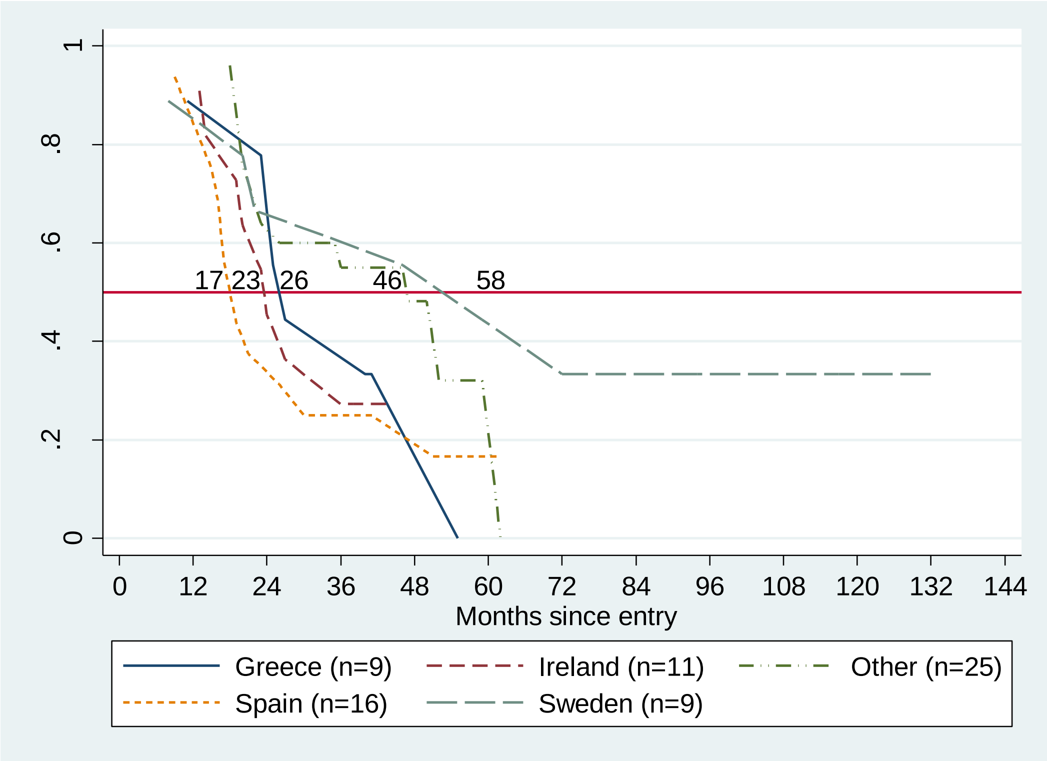


Figure 5.3: Kaplan-Meier survival analysis of retention for migrant dentists by country. * P = 0.0000 by log-rank test.

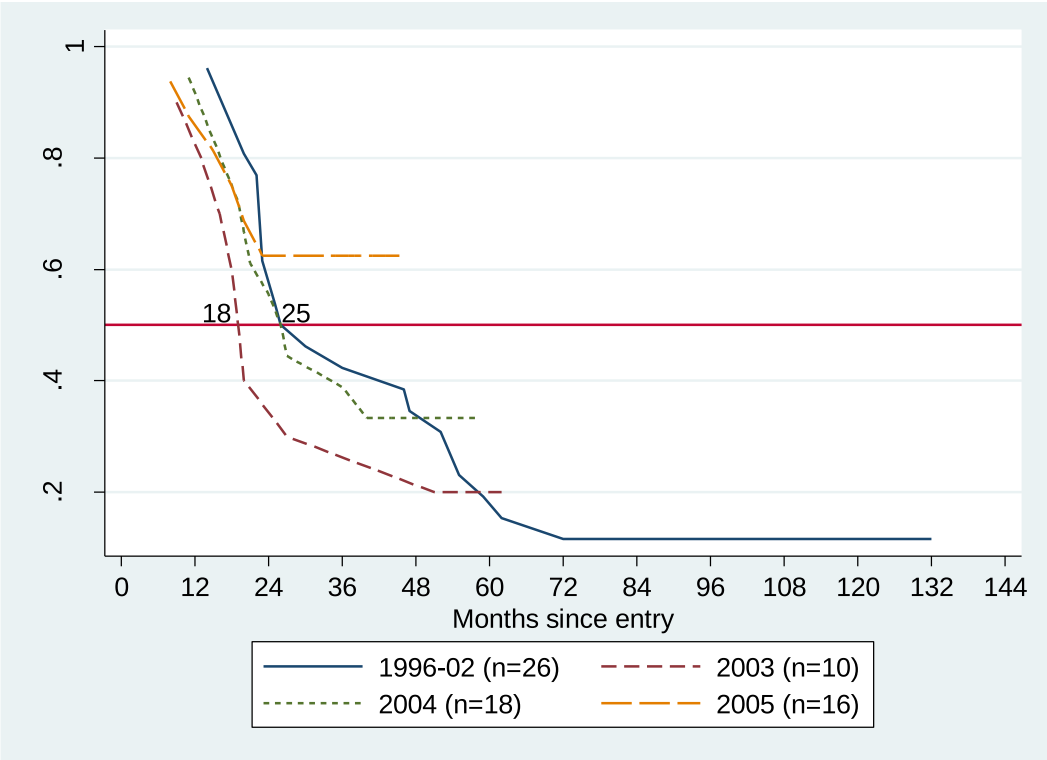


Figure 5.4: Kaplan-Meier survival analysis of retention for migrant dentists by year of entry. * P = 0.0961 by log-rank test.

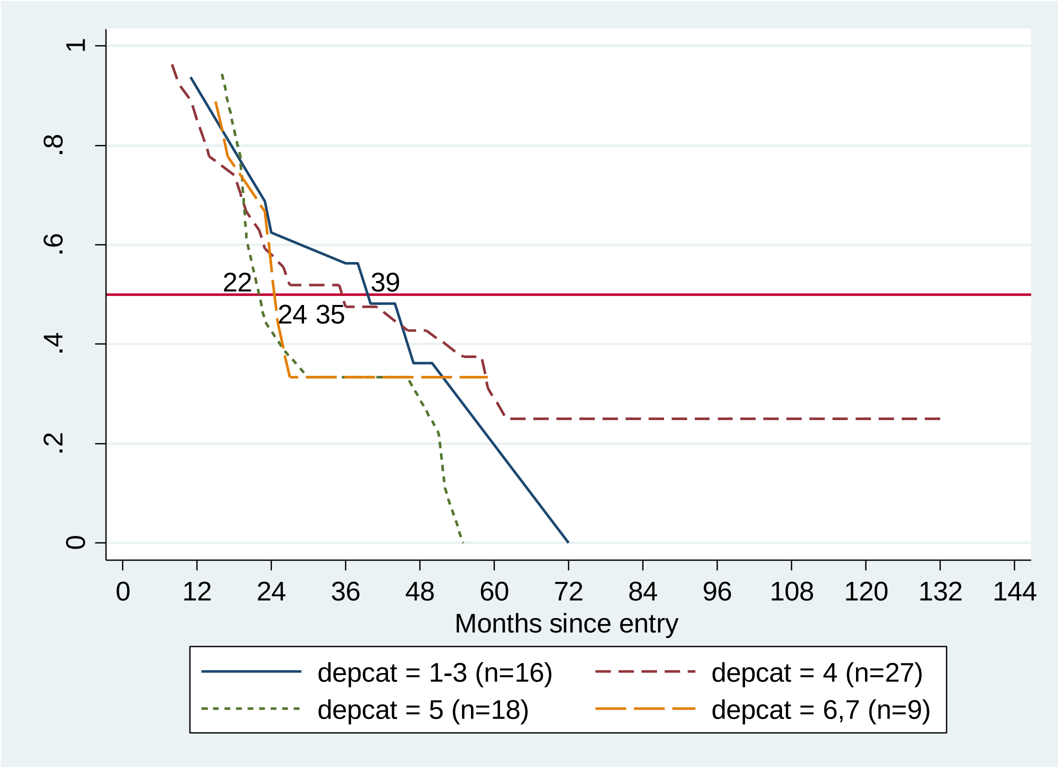


Figure 5.5: Kaplan-Meier survival analysis of retention for migrant dentists by deprivation category of the practice (1-affluent, 7-deprived). * P = 0.0005 by log-rank test.

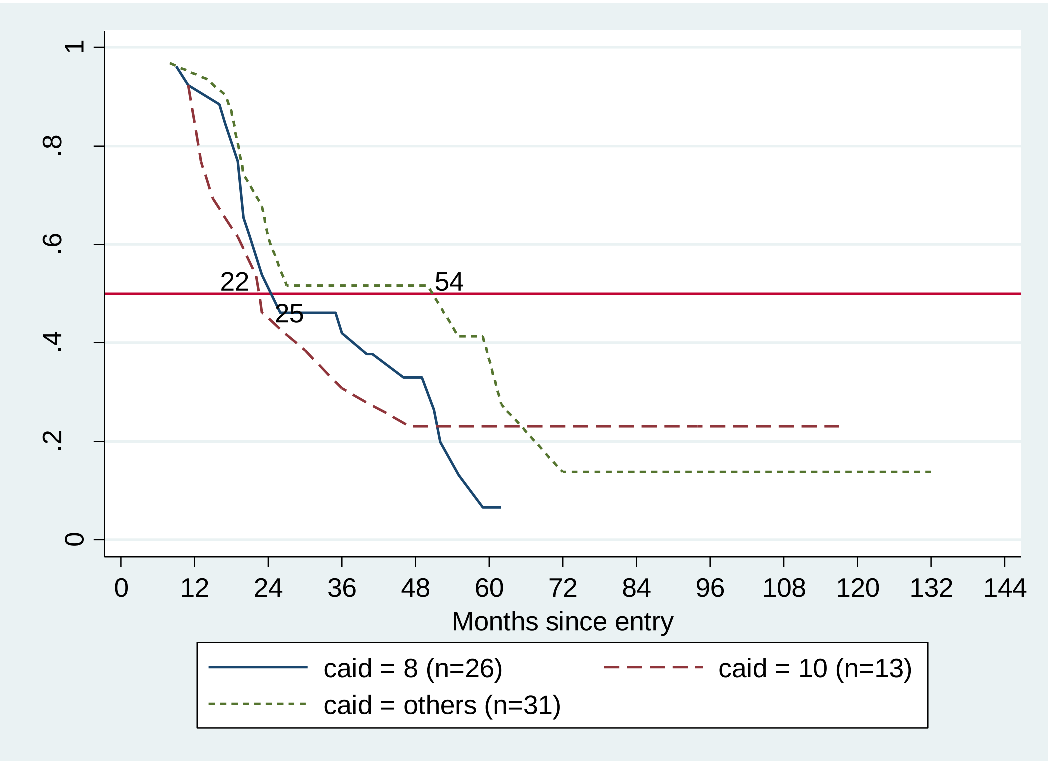


Figure 5.6: Kaplan-Meier survival analysis of retention for migrant dentists by health board (caid=1-8,10-12,14,30). * P = 0.0226 by log-rank test.

In order to generate simpler combined categorical variables to be included in the subsequent regression models, we examine the effect of dentist's country, year of entry and practice deprivation in more detail. Figure 5.3 shows the variations in the migrant dentists' retention among countries. As indicated, dentists from different country groups have very similar patterns of retention in the GDS in the early periods of the career: all of them left quite fast during the first 2 years after entry. The survival estimates bifurcate in the beginning of the second year: dentists from Spain, Ireland and Greece continued the high rate of leaving, while dentists from Sweden and other countries slowed down their pace. The group consisting of dentists from other countries leaving sped up again from the 45th month, and the Swedish group maintained a slow rate over the whole career. Given the similarity of survival estimates among dentists from Greece, Ireland, and Spain (*P*=0.6414 by the log-rank test), we merge these three groups into a new country group for subsequent regression modelling.

Figure 5.4 compares the retention of dentists according to the year when they provided the first treatment in the GDS. Dentists who joined the service before 2003 have the longest retention (median tenure = 25 months) while those in 2003 have the shortest (median tenure = 18 months). The arrival cohorts of 2004 and 2005 follow a very similar pattern of cohort 2003 (*P*=0.5516 by log-rank test), so we use the year of 2003 as a threshold to define the arrival cohort of entrants.

Figure 5.5 indicates the effect of the deprivation category of the practice on dentists' retention behaviour. Log-rank tests suggest significantly different retention among the overall four groups (*P*=0.0005), but with no significant differences between the groups 1-3 and 4 (*P*=0.1613) or between the groups 5 and 6, 7 (*P*=0.2795). Therefore, we generate a new dummy variable for deprived practice which equals one when the deprecation category is larger than 4, and zero otherwise. Overall, dentists who practised in affluent areas stayed longer in the Scottish GDS than those in deprived areas. The difference does not emerge until the beginning of the 2nd year, when dentists in deprived practices (depcat≥5) leave the service at a continually high rate, while the dentists in affluent practices (depcat≤4) have a reduction in their risk of leaving.

5.4.3 Hazard regression modelling

To identify factors that are associated with a non-UK dentist's likelihood of leaving the Scottish GDS, we apply a discrete-time proportional hazard (complementary log-log) modelling technique in a multivariate setting. Influences considered include dentist personal characteristics, practice characteristics, patient composition, and dentist overall treatment provision (two measures) (see Table 5.2 for descriptive statistics). To preserve degrees of freedom, categorical variables are examined with the simpler combined categories.

The duration dependency of the hazard function is also of particular interest to this study. In selecting the proper specification for the baseline hazard, we were constrained by the small sample size in that only 70 migrant dentists joined the Scottish GDS before 2006 and experienced only 49 events by the end of data collection. The traditional flexible stepwise baseline hazard function is considered inappropriate as it includes too many interval dummy variables. Instead, we consider a series of baseline hazard specifications: polynomial function of time and logarithmic time (e.g. linear, quadratic and cubic), a wide stepwise function which include a dummy variable for each half-year interval within the first four years after entry and a dummy for the months thereafter, a LOWESS function with a 30% bandwidth (selected from 25% to 80% at 5% intervals), and a cubic spline function with 2 interior knots (selected from 1 to 4). Complementary log-log regressions were estimated only controlling for effects of the baseline hazard. Table 5.4 compares goodness-of-fitting of these models using likelihood ratio tests (for nested models), and minimizing the Akaike Information

Criterion (AIC)[15] (for non-nested models). Likelihood ratio tests suggest quadratic functions, both of time and logarithmic time, fit the data better than linear and cubic functions. Moreover, the LOWESS specification, which models the duration dependency completely flexibly, has the lowest AIC (449.10) as expected. This is followed by the stepwise specification (AIC = 460.08) and the quadratic function of logarithmic time (AIC = 460.35). Since the stepwise specification includes too many variables, we employed both the LOWESS specification and the quadratic function of logarithmic time in subsequent multivariate modelling, and in particular, the latter one which allows for explicit characterization of the duration dependency. To illustrate the distribution of the hazard function, predictions for these entire baseline hazard models are plotted in Figure 5.7, which indicate an inverse U-shaped distribution throughout.

Table 5.4: Goodness-of-fitting statistics for variorums baseline hazard functions.

Specification	Function	LR test p-value	Log likelihood	AIC
Linear	$H = \alpha_0 + \alpha_1 t$		-239.4	482.89
Quadratic	$H = \alpha_0 + \alpha_1 t + \alpha_2 t^2$	0.000	-233.4	472.74
Cubic	$H = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t^3$	0.250	-232.3	472.63
Linear log	$H = \alpha_0 + \alpha_1 \ln t$		-236.9	477.74
Quadratic log	$H = \alpha_0 + \alpha_1 \ln t + \alpha_2 \ln t^2$	0.005	-227.2	460.35
Cubic log	$H = \alpha_0 + \alpha_1 \ln t + \alpha_2 \ln t^2 + \alpha_3 \ln t^3$	0.146	-226.5	461.03
Stepwise	$H = \alpha_0 + \sum_2^9 \alpha_i \mathrm{Half\_year}_i$		-221.0	460.08
LOWESS	$H = \alpha_0 + \alpha_1 \mathrm{Lowes}(t)$		-222.6	449.10
Spline	$H = \alpha_0 + \alpha_1 t + \alpha_2 \mathrm{Spline1(t)} + \alpha_3 \mathrm{Spline2}(t)$		-226.3	460.57

[15] The AIC is defined as -2 times the log likelihood plus 2 times the sum of number of covariates and number of structure parameters to penalize each covariate included in the model.

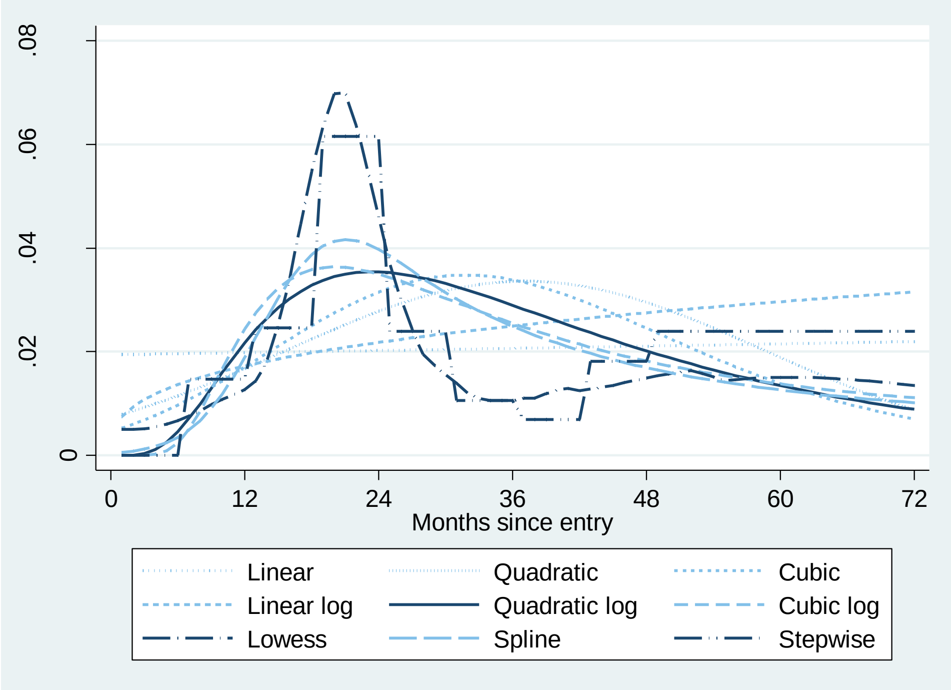


Figure 5.7: Within-sample predictions of hazard distribution for various baseline hazard functions.

The proportionality assumption was examined for each variable by including a relevant interaction term with $\log(t)$. A forward stepwise modelling procedure was employed with time-interactive variables entered in order, using the significance level of 5% and likelihood ratio tests as the criteria for retaining. Across the specifications analysed, the proportional assumption holds for all variables except the arrival cohort dummy and percentage male patients. The findings are consistent when we re-examine the proportional hazard assumption by testing the Schoenfeld residuals from Cox models at the significance level of 5%.

Estimation results of multivariate proportional hazard models are presented in Tables 5.5 and 5.6. Tables 5.5 compares different specifications in terms of different measures of variables, baseline functions and link functions with no unobserved heterogeneity controlled for, while Tables 5.6 only includes variables that are estimated with significance effects in the preferred Specification C and take unobserved heterogeneity into account. For each of the specifications reported, the null hypothesis that all the explanatory variables are jointly equal to zero is rejected by likelihood ratio tests (P=0.000 for all specifications). Standard errors were corrected for both heteroskedasticity across dentists and within-dentist correlation using robust cluster variance estimation except Specifications Gi and Gii, where dentist-specific effects are accounted for.

Table 5.5: Regression results of multivariate proportional hazard models.

Specification	**A**	**B**	**C**	**D**	**E**	**F**
				Logit		
Baseline hazard						
LOWESS t	57.6190*	55.6844*				43.7416*
	[11.8819]	[12.1801]				[10.1804]
Ln t			27.7087*	27.8453*		
			[6.7135]	[6.6295]		
Ln t^2			-2.5788*	-2.6028*		
			[0.6634]	[0.6681]		
Splines						
s0_constant					9.2474*	
					[3.4378]	
s1_constant					0.0124	
					[1.5897]	
Dentist overall treatment provision						
Summation of monthly treatment fees over the whole career (£100)						
meanfeesperm	-0.0087					
	[0.0088]					
Normalised prior monthly treatment fees (£100)						
nfeesperm6		-0.0177*	-0.0198*	-0.0198*	-0.0180*	-0.0114*
		[0.0083]	[0.0078]	[0.0078]	[0.0067]	[0.0058]
Dentist personal characteristics						
Age-at-entry	-0.6494*	-0.7207*	-0.6877*	-0.6924*	-0.6659*	-0.3757*
	[0.2037]	[0.2179]	[0.1868]	[0.2052]	[0.1881]	[0.1293]
Age^2/100	0.9665*	1.0611*	1.0212*	1.0280*	1.0034*	0.4724*
	[0.2899]	[0.3097]	[0.2542]	[0.2848]	[0.2651]	[0.1706]
Male	0.1149	0.1398	0.0177	0.0157	0.1477	0.1896
	[0.3580]	[0.3588]	[0.3958]	[0.4074]	[0.3735]	[0.2948]
Country (ref. Greece, Ireland & Spain)						
Sweden	-2.2223*	-1.8187+	-1.5526	-1.5864+	-1.9886*	-1.1013
	[1.0017]	[1.0104]	[0.9456]	[0.9605]	[0.8285]	[0.7358]
Other	-0.6111	-0.4538	-0.3024	-0.3324	-0.2824	-0.3891
	[0.4628]	[0.4480]	[0.4810]	[0.5020]	[0.4463]	[0.3079]
Year of entry (ref. 1996-02)						
2003-05	4.6961+	6.2375*	10.1630*	10.1734*	7.5155*	1.0937
	[2.3997]	[2.6911]	[3.3332]	[3.3139]	[3.2046]	[1.4711]
2003-05*ln(t)	-1.6195*	-2.0807*	-3.3225*	-3.3389*		-0.5663

	[0.7097]	[0.8106]	[0.9915]	[0.9884]		[0.4751]
s0_2003-05					-2.1370*	
					[0.8598]	
s1_2003-05					-0.1478	
					[0.3569]	
Practice characteristics						
Deprivation category (ref. Affluent: depcat≤4)						
Deprived: depcat≥5	0.4617	0.3333	0.3639	0.3676	0.4296	0.3824
	[0.4797]	[0.4947]	[0.5595]	[0.5584]	[0.4452]	[0.2937]
Health board (ref. Caid=8)						
Caid=10	0.5088	0.4479	0.4347	0.4223	0.5814	0.2564
	[0.5389]	[0.5186]	[0.4973]	[0.5098]	[0.4991]	[0.4398]
Caid=1-7,11,12,14,30	0.2476	0.1381	-0.0971	-0.0771	0.0301	-0.3568
	[0.6921]	[0.6969]	[0.5174]	[0.5231]	[0.4674]	[0.3246]
Patient composition						
%Male patients	-8.0318	-6.0761	70.7736*	70.7071*	47.5931+	
	[8.5327]	[8.9289]	[25.3807]	[24.6934]	[26.5743]	
%Male*ln(t)	4.0967*	3.7632*	-20.4028*	-20.3512*		
	[1.3422]	[1.3497]	[7.2771]	[7.1205]		
s0_%Male					-11.7963	
					[7.2001]	
s1_%Male					1.9339	
					[3.3988]	
Average patient age						
Page	1.6197*	1.7071*	2.0440*	2.0664*	1.8217*	
	[0.7374]	[0.7270]	[0.6411]	[0.7055]	[0.6339]	
Page^2/100	-2.2192*	-2.2970*	-2.6571*	-2.6906*	-2.3975*	
	[1.0193]	[0.9948]	[0.8717]	[0.9493]	[0.8442]	
% Exempt patients	-1.7905	-0.8243	-1.7465	-1.6696	-1.6004	
	[2.2633]	[2.2533]	[3.2568]	[3.2171]	[2.2987]	
Constant	-24.8236*	-26.9807*	-94.8036*	-95.2729*	-59.0920*	2.3169
	[10.0861]	[9.8808]	[17.3373]	[17.9429]	[15.2652]	[2.2014]
Log likelihood	-198.62	-192.70	-192.72	-193.09	-40.23	-207.62
AIC	433.23	421.40	423.43	424.19	122.47	441.24
Ho: All covariates except constant=0						
Likelihood ratio statistics	81.74	73.53	73.50	72.74	64.82	43.69
p-value	0.000	0.000	0.000	0.000	0.000	0.000
EPV[16]	2.9	2.9	2.7	2.7	2.5	4.1
N	2415	1973	1973	1973	1973	1973

Standard errors are in square brackets.
* significant at the 5% level.
+ significant at the 10% level.

The first two specifications of Tables 5.5 present tests for choosing the proper measure of dentist overall treatment provision. Since duration dependency is not of interest for this stage, we include a LOWESS function of time as the baseline hazard.

All variables were fitted into a discrete-time proportional hazard model (cloglog) with no unobserved heterogeneity. Specification A includes a static summation measure (*meanfeesperm*), whereas Specification B uses normalised monthly treatment fees of the past six practice months (in constant SDR107 prices) (*nfeesperm6*) to capture dentists' prior relative productivity. Comparing across the two specifications, it can be seen that both measures allow for capturing the negative effect of dentists' overall treatment provision on their stay-or-leave decision, although the effect of the average monthly treatment fees over the whole career (*meanfeesperm*) is not statistically significant (*P*=0.328). The direction and significance of other coefficient estimates are much the same across the two specifications. In particular, Specification B has a log-likelihood that that is 5.91 log-points higher, indicating a better goodness-of-fit when allowing for the dynamic of individual circumstances. The dynamic measure is thus a better choice for modelling the effect of dentist overall treatment provision.

Specification C estimates the same model of Specification B with the preferred quadratic baseline hazard function to provide explicit inferences of the duration dependency. Although the quadratic function of logarithmic time cannot flexibly model the duration dependency as the local linear regression function (LOWESS) does, the overall fitting of the two models are very similar (Log-likelihood = -192.70 for Specification B, and -192.72 for Specification C).

The next two specifications provide robustness checks. Specification D reports the results of estimating a proportional odds specification (logit), which fits the data less well than the proportional hazard specification (Log-likelihood = -193.093, 0.38 log-points lower than Specification C). Specification E reports the results of estimating a flexible parametric specification at the hazard scale using the Stata module "stpm" written by Royston (2001; revised 2007). The baseline hazard function is smoothed using a natural cubic spline function with one interior knot at the 50th percentile of the diction of the uncensored log times. The number of interior knots was selected from 0 to 5 using minimising AIC. Despite the different coefficient magnitude, which is not directly comparable between the two specifications given the different baseline hazard rates, the covariate effects seem to be robustly estimated with identical signs and significances.

Across the specifications analysed, we obtained the same set of factors that are closely associated with the hazard of dentists leaving the service, including age-at-entry, year of entry, percentage male patients, average age of patients and relative prior overall treatment provision (nfeesperm6). After adjusting for these variables, no statistically significant difference in the hazard rate was found by gender (P=0.964 in Specification C for example), combined country groups (P=0.2595), deprivation categories of the practice (P=0.515), or combined health boards (P=0.4034). The percentage of exempt patients has a negative coefficient parameter across specifications, but none of these effects is significant. In particular, the finding that migrant dentists are indifferent to the location of practice is very interesting and contravenes intuition. One suspicion is that the effect might be captured by patient composition due to the correlation between them. Thus, we estimated Specification F excluding variables for patient characteristics on the basis of Specification B, but still did not find any significant effect of practice deprivation (P=0.193).

Taken together, Specification C is our preferred specification. In Table 5.6, Specification G estimates a better fitted model on its basis only retaining factors with significance. Given that omitted unobserved heterogeneity leads to biased estimation of coefficient parameters, particularly when the baseline hazard function is not completely flexible, we incorporate a random error component to account for unobserved heterogeneity in dentists. Two specifications of the unobserved heterogeneity distributions have been considered: the Gaussian and Gamma distributions.

Specification Gi estimates a random-effects complementary log-log model using the Stata10 command “xtcloglog” with 24 quadrature points. The accuracy of the quadrature approximation was assessed using a sensitivity check by command “quadchk” (STATA9, 2005). Specification Gii estimates the Gamma mixed hazard model proposed by Prentice and Gloeckler (1978) and Meyer (1990) using the Stata module “pgmhaz8” written by Jenkins (2004). The likelihood ratio tests reject the null hypothesis that dentist-specific effects are zero in both specifications (chibar2(01) = 7.37 Prob >= chibar2 = 0.003; chibar2(01) = 4.88 Prob >= chibar2 = 0.014). Comparing across the three specifications, it can be seen that omitted unobserved heterogeneity has the expected impact upon parameter estimates. When heterogeneity correction is not implemented, coefficient estimates are smaller in size, and duration dependence is biased downward as can be observed from hazard predictions of time-dependent effects for these three specifications in Figure 5.8. In choosing the best specification of unobserved heterogeneity distribution, frailty variance is significant at the level of 5% in the Gaussian mixing specification, which has a log-likelihood that is 1.24 log-points higher compared with the Gamma mixing. In what follows, we restrict the discussion of the individual coefficients to the estimates reported in the random effects complementary log-log model (Specification Gi).

Among the controls on dentists’ personal characteristics, only the age-at-entry and year of entry have significant effects on the probability of non-UK qualified dentists leaving the GDS. Age-at-entry has a significant U-shaped effect on the hazard rate with a trough at 35.8 years of age (P=0.0809). A dentist who was 36 at the time of jointing has the lowest risk of leaving, which is estimated as, for example, 19.3% lower than a dentist who was 3 years younger or older at the time of joining. The high hazard rate for young dentists is not surprising, as it has been well documented in the labour literature that the average rates of job changes decrease with age (Topel and Ward, 1992). On the other hand, for dentists who are older at entry, reasonable interpretations could either be the personal preference such as life style and habits that are hard to change because of age, or the lower costs of returning benefit from the established social networks in the original country.

Table 5.6: Regression results of mixed proportional hazard models controlling for unobserved heterogeneity.

Specification	**C**	**G**	**Gi**	**Gii**
			Gaussian	Gamma
Baseline hazard				
Ln t	27.7087*	26.6737*	53.6684*	35.2503*
	[6.7135]	[5.2695]	[20.0208]	[10.8393]
Ln t^2	-2.5788*	-2.6557*	-4.8901*	-3.1757*
	[0.6634]	[0.5978]	[1.6944]	[1.0137]
Dentist personal characteristics				
Age-at-entry	-0.6877*	-0.7092*	-1.7134*	-1.2998*
	[0.1868]	[0.1588]	[0.7687]	[0.5714]
Age^2/100	1.0212*	0.9947*	2.3928*	1.7929*
	[0.2542]	[0.2167]	[1.0670]	[0.7654]
Male	0.0177			
	[0.3958]			
Country (ref. Greece, Ireland & Spain)				
Sweden	-1.5526			
	[0.9456]			
Other	-0.3024			
	[0.4810]			
Year of entry (ref. 1996-02)				
2003-05	10.1630*	9.0399*	17.1997*	13.5246*
	[3.3332]	[2.6788]	[6.8631]	[5.8322]
2003-05*ln(t)	-3.3225*	-2.9446*	-5.4110*	-4.3926*
	[0.9915]	[0.8197]	[2.0937]	[1.8759]
Practice characteristics				
Deprivation category (ref. Affluent: depcat≤4)				
Deprived: depcat≥5	0.3639			
	[0.5595]			
Health board (ref. Caid=8)				
Caid=10	0.4347			
	[0.4973]			
Caid=1-7,11,12,14,30	-0.0971			
	[0.5174]			
Patient composition				
%Male patients	70.7736*	63.2468*	130.2842*	81.9615*
	[25.3807]	[18.2578]	[63.6145]	[34.8600]

%Male*ln(t)	-20.4028*	-18.0662*	-34.4566+	-20.9818*
	[7.2771]	[5.2858]	[18.0034]	[10.6804]
Average patient age				
Page	2.0440*	2.0122*	4.8933*	4.0160*
	[0.6411]	[0.5211]	[2.1800]	[1.5993]
Page^2/100	-2.6571*	-2.6342*	-6.3867*	-5.1664*
	[0.8717]	[0.6918]	[2.8226]	[2.0218]
% Exempt patients	-1.7465			
	[3.2568]			
Dentist overall treatment provision				
Normalised prior monthly treatment fees (£100)				
nfeesperm6	-0.0198*	-0.0223*	-0.0456*	-0.0395*
	[0.0078]	[0.0066]	[0.0140]	[0.0119]
Constant	-94.8036*	-89.5353*	-196.9346*	-142.7543*
	[17.3373]	[14.7712]	[75.7374]	[45.1543]
ln(frailty variance)			2.2168*	1.1498+
			[0.8573]	[0.6899]
Log likelihood	-192.72	-196.29	-192.60	-193.85
AIC	423.43	416.57	411.20	413.69
Ho: All covariates except constant=0				
Likelihood ratio statistics	73.50	66.36	72.82	70.11
p-value	0.000	0.000	0.000	0.000
Ho: Frailty=0				
Likelihood ratio statistics			7.37	4.88
p-value			0.003	0.014
EPV[16]	2.7	4.5	4.5	4.5
N	1973	1973	1973	1973
N_g			70	70

Standard errors are in square brackets.
* significant at the 5% level.
+ significant at the 10% level.

[16] It is necessary to acknowledge the importance of EPV, i.e. the ratio of events per independent variable, in proportional hazards analysis (Concato *et al.*, 1995; Peduzzi *et al.*, 1995; Bradburn *et al.*, 2003). The simulation work by Peduzzi *et al.* (1995) shows that the accuracy, precision, and significance of the regression coefficients estimated by the proportional hazard model will become increasingly unreliable as the EPV decreases. The reliability of our coefficient estimates may be constrained by the small EPV, but our estimates seem to be robust across a variety of specifications. In addition, a sample updating in January 2011 has been proposed to allow for more reliable estimations with larger EPVs.

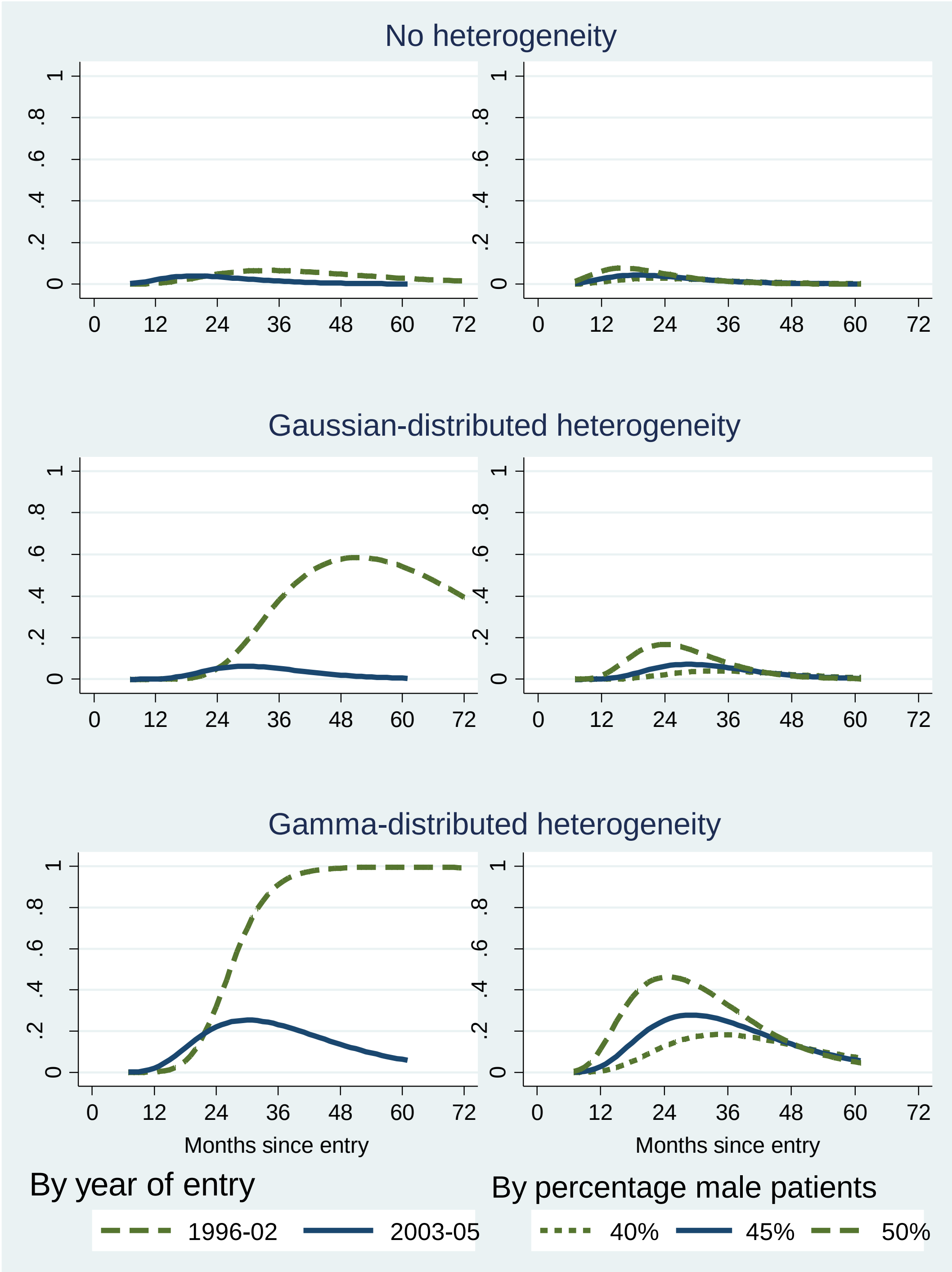


Figure 5.8: Out-of-sample prediction of hazard for the discrete-time proportional hazard model with no unobserved heterogeneity (Specification G), Gaussian-distributed unobserved heterogeneity (Specification Gi), Gamma-distributed unobserved heterogeneity (Specification Gii) for an “average” migrant dentist by (1) year of entry and (2) percentage male patients.

*age-at-entry=30; female; Greece, Ireland or Spain; year of entry=2003-2005 if applicable; deprived=0; caid=8; percentage male patients=44% if applicable; average patient age=40; percentage exempt patients=32%; normalised prior monthly treatment fees=0.

The data also reveals a significant time-varying variation in the trend of retention between cohorts (*P*=0.0342). The coefficient on variable *2003-05* assesses the initial difference in the hazard between dentists who joined the service during the period of 1996-2002 and 2003-2005, while coefficients on the interaction term describes how the difference changes over time. Estimates suggest a positive risk difference between the two cohort groups upon arrival, which reduces to zero at approximately the 24th month[17] after entry, and turns negative thereafter. For better illustration of the duration-dependent effect, we plot the predicted hazard and survival probability against the number of months following entry for a fictitious "average" dentist at different arrival cohorts in Figure 5.9. Hazard predictions are derived by setting all covariates equal to the mean value (age-at-entry=30; female; Greece, Ireland or Spain; Deprived=0; caid=8; normalised prior monthly treatment fees=0; percentage male patients=44%; average patient age=40; percentage exempt patients=32%), and corresponding survival probability is calculated as $\exp\{\mathrm{sum}[\ln(1-\boldsymbol{\lambda}_{it})]\}$. As can be seen, recent entrants are only a little more likely to leave than early entrants during the initial 24 months following entry, but far less likely to leave thereafter. This could be a result of a policy shift; the Dental Action Plan (Scottish Executive 2005) began in April 2005, and gave rise to many more allowances to encourage dentists to work in Scotland. Alternatively, the big difference in later periods could be a simple result of the limited length of the study period. The hazard of dentists finishing work episodes at a given interval is calculated using the frequency of observed episode terminations; there are 88% of dentists of the cohort 1996-02 processing complete work episodes, while only 59% of dentists of the cohort 2003-05 by September 2008.

[17] The result is calculated as (exp(17.1997/5.4110)).

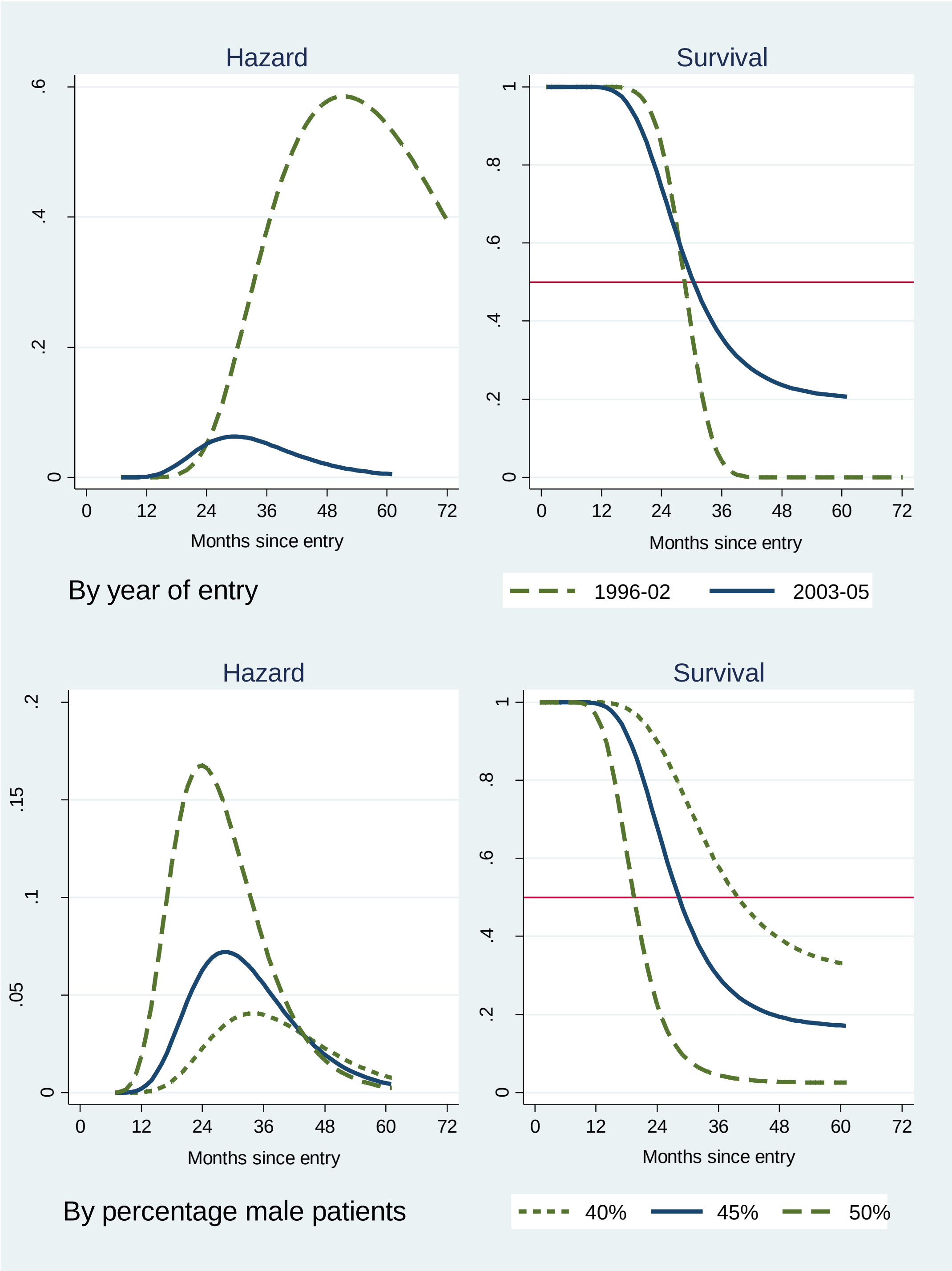


Figure 5.9: Out-of-sample prediction of hazard and survival for the multivariate discrete-time proportional hazard model with Gaussian-distributed unobserved heterogeneity (Specification Gi) for an "average" migrant dentist by (1) year of entry and (2) percentage male patients.

*age-at-entry=30; female; Greece, Ireland or Spain; year of entry=2003-2005 if applicable; deprived=0; caid=8; percentage male patients=44% if applicable; average patient age=40; percentage exempt patients=32%; normalised prior monthly treatment fees=0.

The next two dimensions of risk factors – practice characteristics and patient composition – together capture variations in dentists' working conditions. Estimates suggest that dentists' retention behaviour is closely associated with demographic characteristics of the patients they treated, but not characteristics of their practices. The percentage of male patients being treated is estimated to have a significant positive effect on the hazard rate initially, which reduces to zero at the 44th month[18] after entry. Out-of-sample predictions of the hazard and survival rate for an average dentist are also plotted in Figure 5.9 by 10%, 50% and 90% percentiles of percentage male patients (i.e. 40%, 45% and 50%). Although we only find a significant correlation between the percentage male patients and the hazard rate during the initial 44 months following entry, the predicted survival rates suggest that dentists treating more male patients have shorter retention in the service. In addition, the quadratic in average age of patients has a significant effect on the hazard rate which reaches the peak at 38 (P=0.0750). Overall, the more middle aged and male patients a dentist treats, the higher the risk of leaving. This is likely a result of work burden: our work on treatment intensity in Chapter 6 finds treatment delivered on middle aged and male patients are generally more intensive than treatment otherwise.

Finally, dentists facing lower demand for treatment service are more likely to leave the service: other things equal, a dentist who receives £100 less in monthly treatment fees during past six months when compared with the average fees received by dentists working in the service for the same length of periods, is estimated to be 4.46% (exp(0.0456)-1) more likely to leave in a given month.

5.5 DISCUSSION AND CONCLUSION

This chapter provides a detailed analysis of migrant dentist retention in the Scottish NHS, using a sample derived from administrative data of the Scottish dental system for

[18] The result is calculated as (exp(130.2842/34.4566)).

entrants of 1996-2005. The data shows low retention rates of migrant healthcare professionals: half of the migrants left the service by the 26th month following entry. It is estimated that almost 60% have gone within four years, although this may not be very precise given the small number of dentists remaining in later periods. For ease of comparison, we calculated the average participation rate 5 years after entry is 28.3% between 1996 and 2004, while figures on Scottish DVTs[19] suggest that the average participation rate in NHS Scotland 5 years after VT is 66% between 1991 and 2004, and among whom, those graduated from Scotland have participation rates that are 16%, 29% and 32% higher than graduates from in England, Ireland and Northern Ireland. We acknowledge that the retention examined here only refers to the major Scottish NHS sector, GDS. Dentistry in the UK is quite unique in that GDPs work mainly as independent contractors, and tend to put more focus on their private work, or even completely switch to the private sector after a period of practice in the NHS. It is also possible that these dentists left for other NHS sectors (e.g. Scottish CDS and HDS, or NHS sectors in other UK countries), a new country, or returning to their original countries after obtaining some working/training experience abroad. Collecting detailed information on overseas qualified healthcare professionals' career paths, especially their destination, will enhance effectiveness of workforce planning.

Nevertheless, the high turnover of migrant dentists in the major NHS sector is still likely to be a concern to policy makers in the context of poor access of NHS dental services. The MIDAS data allow us to investigate a full range of potential determinants of retention duration that are rarely available in other datasets. Multivariate analysis in a mixed discrete-time proportional hazards framework provides important insights into retention decisions of migrant dentists, which constitutes this study a potentially important application to workforce planning. First, our results indicate an inverse U-

[19] Data requested from Dr. Colin Tilley from NHS Education for Scotland, 2007.

shaped distribution of the predicted baseline hazard functions peaking through the third practice year (see Figure 5.9) for dentists joining during 2003-05 throughout. Second, retention patterns are found to vary with some personal characteristics: migrants joining the service at around 36 and after 2003 have longer retention duration in the service. Surprisingly, we found no significant variation in retention between men and women or among country groups. These results may help to set evidence-based targets for international recruitment programmes and recruitment initiatives for a more effective improvement on NHS dental access. Third, the insignificant effect of practice deprivation that has been found suggests migrant dentists could be effectively recruited for posts in understaffed socially and economically deprived areas. Finally, we find dentists' retention decisions are closely associated with patient composition: dentists facing more middle aged and male patients, who require more intensive treatment, are more likely to leave.

These findings should be interpreted in the context of the overall limitations present in the data we have used. The reliability of the coefficients may be constrained by the small number of migrant dentists practising in Scotland, but our estimates seem to be robust across a variety of specifications. To preserve degrees of freedom, we combined categorical variables, and modelled the duration dependency using a quadratic function of time instead of the generally favoured flexible stepwise baseline hazard function. Although the quadratic function makes strong assumptions about the hazard distribution, the flexible LOWESS baseline function and the flexible parameter specification which models duration dependency using a natural cubic spine function identified a common set of risk factors.

The lower hazard that has been found for recent entrants (2003-05) suggests the censoring mechanism in our sample does hold some informative value: dentists processing censored work episodes concentrated in the recent arrival cohort, thereby likely to bear lower risk of leaving. This suggests we might have underestimated the retention duration, but it should not affect the observed variations by other risk factors. Nevertheless, this finding raises concern as to what extent the entrants of 1996-2005 in our sample are representative of all migrant dentists in Scotland. The Scottish Executive has introduced a series of NHS access schemes since 2006, such as providing incentives to encourage dentists working in Scotland, developing salaried dental services and directly recruiting dentists from Poland in 2006. The financial support, newly established networks and enhanced employment perspectives are likely to change the composition of new migrant inflows. Therefore, collecting a new sample including the latest entrants with a long sample period for further investigation is necessary to make robust policy recommendations. In addition, the potential endogeneity of dentist overall treatment provision is another issue which warrants further investigation using a large sample.

Whilst this study focuses on migrant dentists working in the Scottish GDS and the data limit the policy implications of the work, our methodology can be applied to other suitable data in order to address various retention issues for healthcare professionals. Investigating how the retention decision making processes differ between native and overseas qualified health professionals and evaluating the effectiveness of recruitment initiatives, for example, are of particular policy interest.

CHAPTER 6

COMPARING TREATMENT OF MIGRANT AND NON-MIGRANT DENTISTS IN THE SCOTTISH NATIONAL HEALTH SERVICE

6.1 INTRODUCTION

Another concern with respect to the migration of health professionals is how migrant professionals provide treatment compared with domestically trained professionals. Also, given the high turnover of migrant dentists in the Scottish GDS highlighted in the previous chapter, to what extent do migrants assimilate into the new health care system. This chapter addresses these issues while controlling for unobserved heterogeneity among dentists using fixed effects method.

International recruitment has become an important tool to address workforce shortages in healthcare in many industrialized countries. There are obvious questions regarding the extent to which migrants are suitable substitutes for domestically trained professionals, especially in the realm of health care, where in the presence of asymmetric information health care professionals have considerable discretion over the type of care they deliver, this raises concerns regarding both the quality and safety of healthcare (OECD, 2008; Simoens and Hurst, 2006). Assessing the extent to which there are differences between internationally recruited and domestically trained health professionals is, therefore, clearly a concern for public policy. Until now, however, there has been little empirical work comparing the services delivered by migrant and indigenously trained health care professionals.

The labour economics literature has long focused on examining the economic assimilation of migrant workers (see the survey in Borjas, 1994). Upon arrival in a host country experiencing a shortage of country exclusive human capital, migrants tend to have a big earning gap as compared to native workers of similar ability (Chiswick, 1980). However, the size of this earnings gap usually diminishes as migrants learn the local language and institutions, accumulate local experience, and adjust their skills to suit local conditions (Eckstein and Yoram, 2003). In general, these studies use earnings as a proxy for skills, with more rapid assimilation rates being found among higher skilled migrants (Friedberg, 2000). More recently, researchers have investigated not only earnings, but also employment in terms of labour force participation and self-employment (see the survey in Dustamn and Fabbri, 2005). It has been argued that labour market participation is more important than wages in migration assimilation in northern and western European countries which have less flexible labour markets coupled with generous welfare systems (Zorlu and Hartog, 2008). In contrast to general migrant workers, a question relevant to migrant health professionals is whether the difference in treatment provided by migrant and non-migrant professionals disappears with time and, if so, how long this process takes. The previous chapter has highlighted a high turnover of migrant dentists in the Scottish GDS. While we may expect that the high degree of transferability of medical education within Europe could reduce assimilation time of health professionals, it is not clear as to what extent the country-specific skills and practice styles developed in original countries could be adjusted to fit with the new health care system within the short stay of migrant dentists in the Scottish GDS.

In light of these issues, this chapter examines whether there are differences between the treatment provided by migrant and non-migrant dentists and whether these differences disappear over time. We again use administrative data from the NHS General Dental Service in Scotland, and target a particular group of migrant health professionals – dentists migrating from EC/EEA countries and contracted under the Scottish National Health Service.

The remainder of this chapter is organised as follows. The next section describes our data, sets out our empirical methodology and presents the empirical results. A difference-in-differences model is estimated to examine how migrant dentists' responses to different case mix and individual circumstances compare with non-migrant dentists' responses, and whether the treatment difference disappears with time as migrants assimilate into the host country. Given the longitudinal nature of the data, we control for time-invariant unobserved heterogeneity in dentists using fixed effects method. However, the dentist fixed effects method cannot identify the initial treatment difference and assumes homogeneous patients such that unobserved dentist-specific characteristics affect treatment delivery in the same way for all patients. Thus, in the penultimate discussion section, we estimate an auxiliary OLS regression of dentist effects estimated to isolate the fixed effect of migrant status, and, at the first attempt, make full use of the matched patient and practitioner data to simultaneously control for patient- and dentist-specific effects using a three-way error-component model. The last section concludes the paper.

6.2 EMPIRICAL FRAMEWORK

6.2.1 Data

As mentioned in Chapter 4, the anonymised treatment data reported in this paper comes from the MIDAS, which is a large-scale administrative database of linked patient-practitioner information that stores all GDS treatment in Scotland. Within each CoT, the patient usually receives a range of items of service, each with an associated fee regularly informed by Doctors' and Dentists' Review Body. The NHS payment system allocates a unique identifier for each patient, GDP, and CoT, making it possible to follow patients, GDPs and types of treatment over time.

The sample of data on migrant and non-migrant dentists was acquired by using the GDC number of dentists issued with a VT number to identify their GDS treatment. For migrant dentists, the sample was restricted to include only dentists who began providing GDS treatment after January 2006. For non-migrant dentists, the sample was restricted to dentists who completed VT in July 2006 and who subsequently provided treatment in the GDS. We can therefore, investigate how a migrant GDP adjusts practice style over time since entry compared with a comparable non-migrant GDP with the same practice experience in the GDS. By doing so, we implicitly assume the influence of previous experience in the source country on practice style is insignificant and remains constant for each GDP throughout the practice. Friedberg (2000) evaluates the importance of domestic- and foreign-source human capital in determining immigrant-native differences in the human-capital corrected earnings, and finds that the return to foreign experience is generally insignificant.

The treatment data for both migrant and non-migrant dentists were restricted to information on adults because there is much more detailed information on the treatment of adults compared to children. The initial sample consisted of 199 migrant GDPs with 264,843 claims and 83 non-migrant GDPs with 217,755 claims paid before September 2008. In order to account for the impact of visit duration on treatment, each patient's first observation was dropped, which reduced the sample to 116,211 claims made by 192 migrant GDPs and 112,394 claims made by 83 non-migrant GDPs. Finally, we focus on treatment provided during the same experience period – the first 24 months after entry. This further reduces the sample size to 107,378 claims made by 192 migrant GDPs and 108,528 claims made by 83 non-migrant GDPs.

Table 6.1 reports descriptive statistics for migrant and non-migrant GDPs. Patients treated by the two groups of GDPs are very similar in terms of their age, gender, exemption status and duration since last visit.

The type of treatment these patients required is also very similar but there are some small differences in the proportion of CoTs in which patients required diagnostic (examinations and x-rays), periodontal (scaling and polishing), and conservative (fillings) treatment.

Table 6.1: Descriptive statistics.

Variable	Description	Non-migrant N	Non-migrant Mean	Non-migrant SD	Migrant N	Migrant Mean	Migrant SD
feesdr107	Total value of the claim (constant SDR107 prices)	108528	36.52	57.54	107378	38.35	56.53
page	The age of the patient	108528	45.25	14.51	107378	45.44	14.43
psex	The sex of the patient (male=1)	108528	0.44	0.50	107378	0.45	0.50
exempt	Exemption status (exempt=1)	108528	0.27	0.44	107378	0.29	0.46
visitdur	Duration since last visit (months)	108528	5.53	3.56	107378	5.76	4.04
diag	Equals 1 if at least one treatment on the claim was a diagnosis item	108528	0.72	0.45	107378	0.70	0.46
prev	Equals 1 if at least one treatment on the claim was a preventive item	108528	0.0006	0.0243	107378	0.0004	0.0193
perio	Equals 1 if at least one treatment on the claim was a periodontal item	108528	0.49	0.50	107378	0.44	0.50
cons	Equals 1 if at least one treatment on the claim was a conservative item	108528	0.36	0.48	107378	0.40	0.49
surg	Equals 1 if at least one treatment on the claim was a surgical item	108528	0.07	0.25	107378	0.08	0.28
prosth	Equals 1 if at least one treatment on the claim was a prosthetic item	108528	0.06	0.23	107378	0.07	0.25
ortho	Equals 1 if at least one treatment on the claim was an orthodontic item	108528	0.0000	0.0053	107378	0.0001	0.0114
other	Equals 1 if at least one treatment on the claim was an ‘other’ item	108528	0.06	0.24	107378	0.07	0.26
occasional	Equals 1 if at least one treatment on the claim was an occasional item	108528	0.01	0.07	107378	0.01	0.11
incomplete	Equals 1 if at least one treatment on the claim was an ‘incomplete’ item	108528	0.005	0.068	107378	0.010	0.101
misc	Equals 1 if at least one treatment on the claim was a ‘miscellaneous’ item	108528	0.20	0.40	107378	0.22	0.42
trauma	Equals 1 if at the claim was characterized by trauma	108528	0.0012	0.0345	107378	0.0010	0.0314
enterage	The age of the dentist at the first treatment in the GDS	83	25.29	2.26	192	34.36	8.83
dsex	The sex of the dentist (male=1)	83	0.49	0.50	192	0.48	0.50
sal	Remuneration structure (salaried=1)	83	0.02	0.15	192	0.19	0.40
se	Remuneration structure (self-employed=1)	83	0.98	0.15	192	0.83	0.38
Exp_0-6	Equals 1 if less than 6 months elapsed since the first treatment	108528	0.09	0.29	107378	0.21	0.40
Exp_7-12	Equals 1 if 7-12 months elapsed since the first treatment	108528	0.28	0.45	107378	0.31	0.46
Exp_13-18	Equals 1 if 13-18 months elapsed since the first treatment	108528	0.32	0.47	107378	0.27	0.44
Exp_19-24	Equals 1 if 19-24 months elapsed since the first treatment	108528	0.31	0.46	107378	0.21	0.41
depcat	The deprivation category of the dentist’s practice (1/7=least/most deprived)						
caid	Health board ID (anonymous)						

Dentist characteristics differ between the two groups, though. The average age-at-entry of the migrant GDPs was 34, 9 years older than the non-migrants. Non-migrant dentists were more likely to be non-salaried than migrant dentists, perhaps as a result of the Scottish Executive's recruitment initiative introduced in Chapter 4. The distribution of CoTs by deprivation category of the practice (1/7 = least/most deprived) presented in Figure 6.1 also shows that migrant dentists work in practices more deprived than non-migrants.

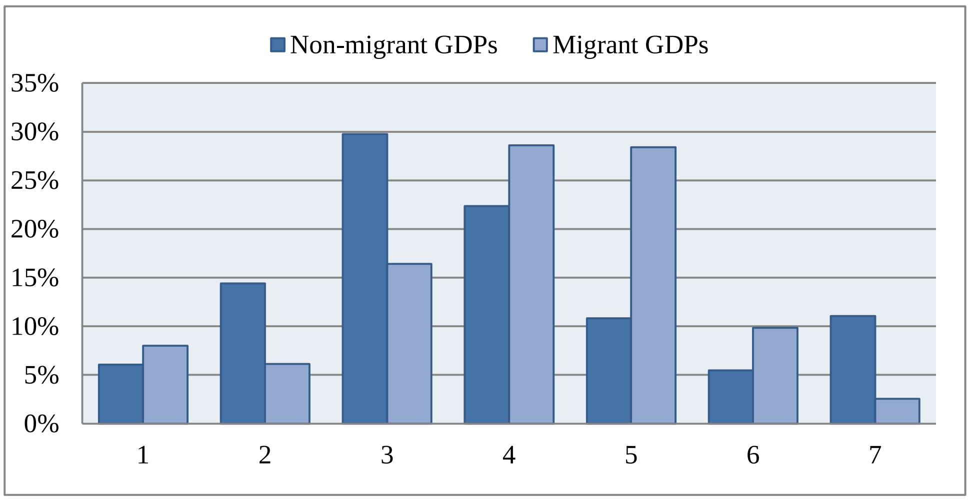


Figure 6.1: Distribution of GDPs by deprivation category of the practice.

Within the sample period migrant dentists provide more treatment (by value) per CoT as compared to non-migrants (£38.22 vs. £36.55). However, following Friedberg (2000), Figure 6.2 shows how the mean value of treatment per CoT changes during the sample period. It suggests that while there is some difference between migrant and non-migrant dentists initially, there is convergence in the mean value per CoT from the fifth quarter after entry onwards.

Figure 6.2 also indicates that both groups of GDPs demonstrate that there is an initial period during which the mean value per CoT increases probably as a result of the claims process: during the first few months only short and therefore relatively low value

CoTs will be processed. Thus, we focus on the treatment provided after the second month after entry. This reduces the sample size to 103,412 claims made by 179 migrant GDPs and 107,668 claims made by 82 non-migrant GDPs.

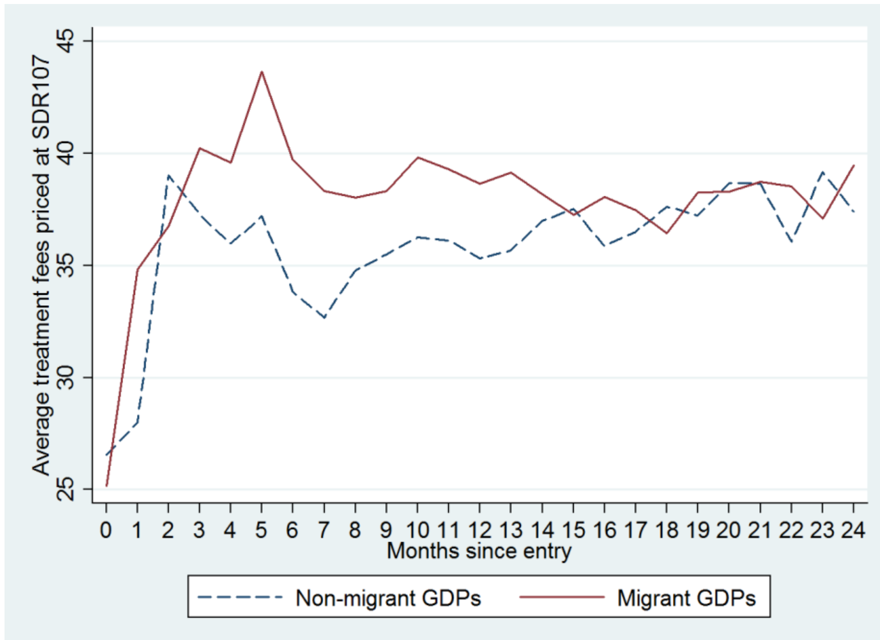


Figure 6.2: Treatment value for migrant and non-migrant GDPs over time.

6.2.2 Regression methods

The traditional Labour Economics literature has highlighted a speedy assimilation process by general migrant workers as they learn the local language and institutions, accumulate local experience, and adjust skills to suit local labour markets (Eckstein and Yoram, 2003). In the present study, while it is likely that healthcare professionals have developed country-specific skills and practice styles from the previous training and working experience in their country of origin, the descriptive statistics do suggest some degree of convergence by migrant GDPs to their non-migrant counterparts (see Figure 6.2). We attempt to capture these individual specific effects and potential convergence in treatment by estimating the following difference-in-differences (DiD) model:

$$\ln(y_{ijk}) = \alpha M_j + \theta Z_{ijk} + \lambda Z_{ijk} M_j + \sum \gamma_g Exp\_g_{ijk} + \sum \delta_g Exp\_g_{ijk} M_j + u_i + v_j + \varepsilon_{ijk}, \qquad (6.1)$$

where y_{ijk} is the value of the *k*th CoT provided by dentist *j* for patient *i*'s *k*th CoT; M_j is a dummy variable indicating a migrant GDP; Z_{ijk} denotes a set of controls such as patient characteristics and the broad treatment categories reported in Table 6.1 that vary across patients, dentists and CoTs; Exp_g is a vector of binary variables indicating dentist experience by every six months elapsed since the first treatment (g∈{3-6, 6-12, 13-18, 19-24}; the reference category is the 2nd month after entry); μ_i and v_j are patient- and dentist-specific effects capturing unobserved heterogeneity between patients and dentists, respectively; and ε_{ik} is a pure random error orthogonal to all explanatory variables.

The administrative data we use here are not standard as in the more common types of panel data in the sense that dental treatments are not delivered at the same time points or even intervals, so the *k* subscript in model (1) is an ordinal number indicating the order of treatments within each unique patient-dentist combination (or "spell"), rather than the time-series dimension. We assume that there is no correlation between the residuals of different patient-dentist match across each *k*-th CoTs, and therefore, do not include the unobservable order-specific effect. Our specification does not consider time-specific effects given the short sample period we have and also the high correlation between dentist experience and year dummies. However, a variable reflecting the time duration elapsed since the patient's last visit is included to control for the potential dependence in observations over time.

The DiD model allows us to test whether migrant and non-migrant dentists behave differently from each other in practice[20]. The coefficients on the interactions between the

[20] We can also estimate models separately for migrant and non-migrant GDPs, but, by doing so, we lose information on patients who are treated by both types of dentists, which contributes to the identification of the three-way error-component model in section 6.3.2 which accounts for both patient- and dentist-specific unobserved heterogeneity.

migrant dummy and treatment category indicators, *prev*m*, *perio*m*, ..., *misc*m*, capture differences in the practise styles of migrant and non-migrant GDPs. The coefficient on the interactions between the migrant dummy and experience category variable, *Exp_g*m*, captures the rate that migrant GDPs adjust treatment intensity over time, relative to the non-migrant GDPs, while allowing for their initial difference at the reference experience category, α. We can calculate the assimilation rate (i.e. the rate of reduction in treatment difference between migrant and non-migrant GDPs) during the period from t_0 to t_1 as $E(\delta_g|t_1) - E(\delta_g|t_0)$, where month 3-6 $\leq t_0 \leq t_1 \leq$ month 19-24. A quicker assimilation rate implies that treatments between migrant and non-migrants converge faster, and vice versa.

The fixed effects estimation method, which treats unobservable effects as a parameter to be estimated rather than part of the residuals, is preferred in our analysis to allow for arbitrary correlation between unobservable effects and observed explanatory variables. The data allow us to control precisely for dentist effects by recording all treatments that have been provided by each dentist (mean N=831.3) over the sample period. Therefore, we estimate the dentist fixed effects version of Equation (6.1), which assumes heterogeneous dentists by including a different intercept for each dentist, but homogeneous patients by setting patient effects jointly to zero:

$$\begin{aligned} \ln(y_{ijk}) = \alpha M_j + \theta Z_{ijk} + \lambda Z_{ijk} M_j + \sum \gamma_g Exp\_g_{ijk} \\ + \sum \delta_g Exp\_g_{ijk} M_j + v_j + \varepsilon_{ijk}. \end{aligned} \tag{6.2}$$

It is assumed that treatments on the same patient are independent and that unobserved dentist-specific characteristics affect treatment delivery in the same way for all patients.

6.2.3 Regression results

Table 6.2 presents the results of estimating the treatment intensity function in a dentist fixed effects specification. An F-test that all regressors are jointly equal to zero is rejected (F(74,210745)=4461.27, Prob>F=0.0000). Standard errors are corrected for both heteroskedasticity across dentists and within-dentist correlation using robust cluster variance estimation.

Table 6.2: Estimation results of the dentist fixed effects model.

Assimilation estimates (ref. group: Exp_2)			
Exp_3-6	-0.0092	Exp_3-6*m	0.0389
	[0.0307]		[0.0350]
Exp_7-12	0.003	Exp_7-12*m	0.0484
	[0.0297]		[0.0339]
Exp_13-18	0.0115	Exp_13-18*m	0.0318
	[0.0298]		[0.0349]
Exp_19-24	0.0186	Exp_19-24*m	0.0052
	[0.0303]		[0.0360]
Case mix			
prev	0.7394*	prev*m	0.0319
	[0.1318]		[0.2011]
perio	0.6885*	perio*m	-0.0061
	[0.0130]		[0.0177]
cons	1.1777*	cons *m	-0.0104
	[0.0191]		[0.0262]
surg	0.6270*	surg*m	0.0344
	[0.0157]		[0.0215]
prosth	1.4709*	prosth*m	0.1122*
	[0.0262]		[0.0372]
ortho	1.1839	ortho*m	0.8166
	[0.8176]		[0.9958]
other	0.0557+	other*m	-0.0261
	[0.0283]		[0.0373]
occasional	0.6180*	occasional*m	-0.0792
	[0.0494]		[0.0643]
incomplete	0.6061*	incomplete *m	-0.1448
	[0.0854]		[0.0970]
misc	-0.0225	misc*m	0.0034
	[0.0196]		[0.0254]
trauma	0.1122	trauma*m	0.0639
	[0.0680]		[0.0944]

Remuneration			
sal	Yes	sal*m	Yes
exempt	0.0896*	exempt*m	0.0206
	[0.0163]		[0.0211]
Patient characteristics			
page	0.0031*	page*m	-0.0016
	[0.0011]		[0.0016]
page^2/100	-0.0048*	page^2/100*m	0.0021
	[0.0010]		[0.0016]
psex	0.0137*	psex*m	0.0111*
	[0.0041]		[0.0055]
visitdur	0.0395*	visitdur*m	-0.0015
	[0.0033]		[0.0039]
visitdur^2/100	-0.1459*	visitdur^2/100*m	0.0066
	[0.0171]		[0.0202]
Practice deprivation (ref. group: depcat4)			
depcat	Yes	depcat*m	Yes
Health board (ref. group: caid5)			
caid	Yes	caid*m	Yes
_cons	1.5410*		
	[0.1143]		
F	4461.27	N	211080
r2	0.61	N_g	261
r2_a	0.61	g_avg	808.74
r2_o	0.32	sigma_u	0.67
r2_w	0.61	sigma_e	0.56
r2_b	0.08	rho	0.58

For confidentiality reasons, we do not report coefficients on binary variables and responding interaction variables that are identified with small number of dentists, such as dentist contract (sal, sal*m), practice deprivation (depcat, depcat*m) and NHS Health Board (caid, caid*m).
Standard errors are in square brackets.
* significant at the 5% level.
\+ significant at the 10% level.

The random effects estimation method which produces efficient estimates exploring both within- and between-variance of the data is also employed on the data. The Hausman test (Hausman and Taylor, 1981) rejected the random effects model (χ^2(57)=386.35, Prob> χ^2=0.0000) and dentist effects estimated in the fixed effects model are significantly different from zero (F(260, 210745) = 11.93, Prob > F = 0.0000) and account for as much as 58% of the variation in treatment value (ρ=0.58).

In what follows, we focus on the difference-in-differences variables to examine how a migrant GDP responds to the various case mix and personal circumstances relative to a comparable non-migrant GDP, and, after adjusting for observed variables and dentist fixed effects, how their treatment differences vary with time.

Variations in patient dental conditions are captured by indicator variables for the broad treatment categories defined in the SDR and a dummy variable for treatment required arose as a result of trauma. An F-test that interaction variables between the migrant dummy and treatment category indicators are jointly equal to zero is not rejected at the 5% of significant level (P=0.0575), which suggests migrant and non-migrant GDPs deliver similar treatment for various treatment categories. The only exception is for the prosthetic treatment: migrant GDPs provide significantly more treatment for patients who require for prosthetic treatment (11.22%, P=0.003) compared with non-migrant GDPs.

Dummy variables for a dentist's contract (salaried or not) and each patient's exemption status captures how dentists respond to remuneration structure and demand-side cost-sharing, respectively. The coefficients on dentist contract and its interaction are based upon the 2 (or 0.8% of the sample) GDPs who switched contracts during the sample period and therefore, are not reported for confidentiality reasons. Non-migrant GDPs provide exempt patients with 8.96% more treatment than non-exempt patients (P=0.000) and the interaction term shows that there is no significant difference between migrant and non-migrant dentists in the way they treat exempt and non-exempt patients.

As to the standard patient controls, only the interaction term on the patient gender is significantly different from zero. This suggests that, relative to female patients, male patients receive significantly more treatment from migrant dentists than from non-migrant dentists (1.11%, *P*=0.044). It can be found that, ceteris paribus, male patients at 33 years[21] old receive the highest value of treatment.

The indicator variables for the deprivation category of the practice and NHS Board where the patient receives treatment and their migrant-interactive variables capture the variations in treatment intensity by patients' socioeconomic characteristics and Health Boards. While the individual coefficients are not reported in Table 6.2, F-tests suggest that migrant GDPs provide significantly different treatment relative to non-migrants according to the deprivation category and (separately) NHS Board in which they practise (*P*= 0.000 for both groups of interaction variables).

Migrant and non-migrant GDPs follow significantly different time patterns of treatment value. An F-test that the interaction terms, *Exp_g*m*, are jointly equal to zero is rejected (*P*=0.0006). Using coefficients on the experience variables, generates the treatment experience profiles plotted in Figure 6.3. This shows the treatment difference between migrant and comparable non-migrant GDPs diminishes over time within two years of practice in the GDS. The first two six months see increases of treatment value by both groups, which is likely to be a result of the claim process. Since the second six months, migrant GDPs provide 4.84% more treatment than their non-migrant counterparts relative to the second month after entry; this gap reduces to 3.18% the following six months, and then approaches to zero by the fourth six months post-entry. These insignificant coefficients do not necessarily suggest an insignificant assimilation process as they are being estimated relative to the 2nd month post-entry; whether there is significant convergence or divergence during the sample period depends upon how $\mathrm{E}(\delta_g)$ changes with time. Table 6.3 presents predicted assimilation rates over time. It suggests that, after adjusting for observed heterogeneity across CoTs and dentist fixed effects, there is

[21] The result is calculated as -0.0031/[2×(-0.0048/100)].

significant convergence of migrant GDPs to comparable non-migrants from the 7th to the 24th month since entry: the difference of treatment value reduces significantly by 4.32% (*P*=0.002, 95% confident interval is [-6.97%, -1.67%]).

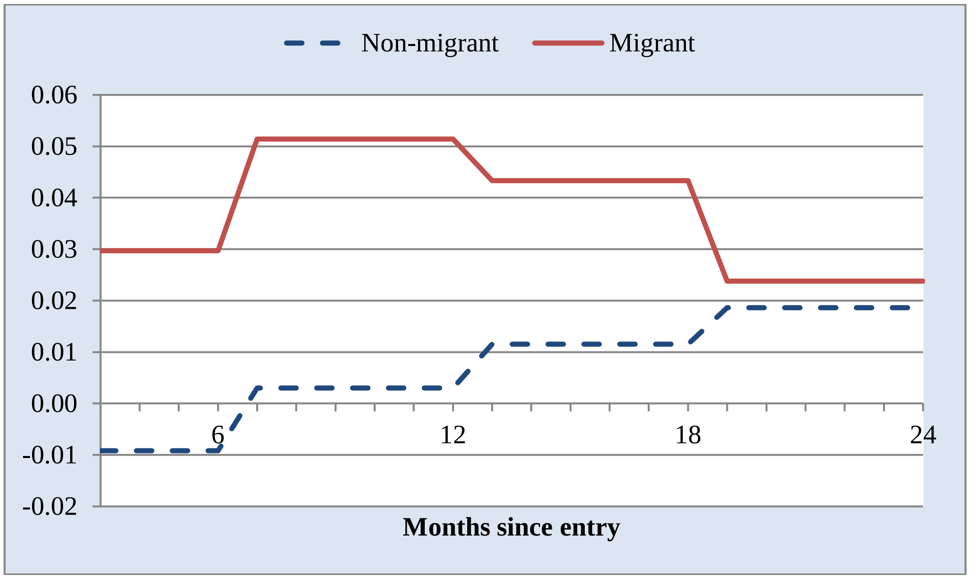


Figure 6.3: Predicted treatment experience profiles for migrant and non-migrant GDPs.

Table 6.3: Predicted assimilation rates.

	Coef.	Std. Err.	P>t	[95% Conf. Interval]	
Exp_7-12 - Exp_3-6	0.0095	0.0154	0.540	[-0.0209,	0.0398]
Exp_13-18 - Exp_7-12	-0.0166	0.0114	0.145	[-0.0390,	0.0058]
Exp_19-24 - Exp_13-18	-0.0266	0.0082	0.001	[-0.0428,	-0.0104]
Exp_19-24 - Exp_7-12	-0.0432	0.0135	0.002	[-0.0697,	-0.0167]

As a robustness check, we estimate the assimilation rate during the period from the 7th to the 24th month in 2 more dentist fixed effects specifications (see Table 6.4 for results). Standard errors are again corrected for both heteroskedasticity across dentists and within-dentist correlation using robust cluster variance estimation. Specification A re-estimates our baseline model reported in Table 6.2, where we set the 2nd half year (i.e. *Exp*_7-12) as the reference group. The assimilation rate can therefore, be directly captured by δ_{19-24}. Specification B replicates specification A but only focuses on the active treatments which contain other items of service rather than only an exam, or only a scale & polish, or both

(Chalkley and Tilley, 2006). These treatments constitute 65% of the sample. Specification C is the same as Specification A, but excludes the variable, *visitdur*, in order to use information on all treatments rather than only on patients' subsequent treatments which allow us to calculate the time duration since the last visit. Comparing the main coefficients of interest – the interactions between migrant dummy and experience category variables *Exp*_19-24*m – across specifications suggests a robust assimilation process for migrant GDPs. During the period from the 7th to the 24th month after entry, the treatment difference between migrant and non-migrant GDPs reduces by an even larger magnitude for all treatments (5.56%) and subsequent active treatments (5.38%) as compared with subsequent treatments (4.33%). All these estimates are found to be statistically significant.

6.3 DISCUSSION

The treatment provided by all migrant dentists who started providing dental services in the GDS after 2006 are compared with the treatment provided by a comparison group consisting of the 2005/06 cohort of Scottish DVTs. We choose a particular cohort of DVTs for comparison rather than a representative sample of the overall DVTs as it carries more policy relevance to compare the outputs of the government recruited migrant GDPs with the outputs of local graduates who entered the service at the same time. By controlling for dentist fixed effects, the treatment difference between these two groups of GDPs at the reference experience category as captured by the time invariant dummy variable, M_j, is eliminated, together with dentist-specific fixed effects, μ_j, by within transformation and therefore, cannot be identified directly. We allow for this initial difference, and restrict our focus on whether the difference disappears over time as migrant GDPs assimilate into the local system. μ_i

Table 6.4: Estimation results across dentist fixed effects specifications.

	A. Incl. *visitdur*	B. Incl. *visitdur* active	C. Excl. *visitdur*
Assimilation estimates (ref. group: Exp_7-12)			
Exp_2-6	-0.0113	-0.013	0.0148*
	[0.0093]	[0.0129]	[0.0073]
Exp_13-18	0.0086	0.0104	-0.0028
	[0.0071]	[0.0098]	[0.0064]
Exp_19-24	0.0156*	0.0179	0.0005
	[0.0077]	[0.0114]	[0.0071]
Exp_2-6*m	-0.0136	-0.0189	-0.0174+
	[0.0148]	[0.0184]	[0.0102]
Exp_13-18*m	-0.0168	-0.0198	-0.0272*
	[0.0114]	[0.0160]	[0.0113]
Exp_19-24*m	-0.0433*	-0.0538*	-0.0556*
	[0.0135]	[0.0195]	[0.0152]
Case mix			
prev	0.7393*	0.7069*	0.8022*
	[0.1319]	[0.1255]	[0.1353]
prev*m	0.0315	0.0066	-0.1707
	[0.2011]	[0.2029]	[0.1622]
perio	0.6884*	0.6067*	0.7249*
	[0.0130]	[0.0157]	[0.0133]
perio*m	-0.0061	-0.0107	-0.0412*
	[0.0177]	[0.0252]	[0.0183]
cons	1.1777*	1.1171*	1.1296*
	[0.0191]	[0.0237]	[0.0153]
cons *m	-0.0104	0.0093	-0.006
	[0.0262]	[0.0307]	[0.0221]
surg	0.6270*	0.5853*	0.5860*
	[0.0157]	[0.0184]	[0.0133]
surg*m	0.0345	0.0420+	0.0054
	[0.0215]	[0.0253]	[0.0179]
prosth	1.4709*	1.4328*	1.5015*
	[0.0262]	[0.0265]	[0.0259]
prosth*m	0.1124*	0.1154*	0.0814*
	[0.0372]	[0.0374]	[0.0323]
ortho	1.1838	1.084	0.9027
	[0.8175]	[0.8124]	[0.8024]
ortho*m	0.8166	0.8483	1.2759
	[0.9958]	[0.9856]	[0.8106]
other	0.0557+	0.0019	0.0492*
	[0.0283]	[0.0273]	[0.0245]

other*m	-0.026	-0.0141	-0.0276
	[0.0373]	[0.0362]	[0.0338]
occasional	0.6180*	0.5185*	0.5662*
	[0.0494]	[0.0526]	[0.0398]
occasional*m	-0.0795	-0.0561	-0.1252*
	[0.0643]	[0.0679]	[0.0564]
incomplete	0.6061*	0.5454*	0.5379*
	[0.0854]	[0.0870]	[0.0820]
incomplete *m	-0.1447	-0.1214	-0.0805
	[0.0970]	[0.0980]	[0.0891]
misc	-0.0225	-0.1043*	-0.0316*
	[0.0196]	[0.0258]	[0.0158]
misc*m	0.0034	0.0342	0.0308
	[0.0254]	[0.0332]	[0.0204]
trauma	0.1125+	0.1593	0.1333*
	[0.0681]	[0.0969]	[0.0558]
trauma*m	0.0633	0.0402	-0.0327
	[0.0945]	[0.1224]	[0.0680]
captreat	(dropped)	(dropped)	-0.1690*
			[0.0160]
captreat*m	(dropped)	(dropped)	1.8337*
			[0.0221]
Remuneration			
sal	Yes	Yes	Yes
sa1*m	Yes	Yes	Yes
exempt	0.0896*	0.1288*	0.0985*
	[0.0163]	[0.0209]	[0.0126]
exempt*m	0.0206	0.0188	-0.0042
	[0.0211]	[0.0279]	[0.0155]
Patient characteristics			
page	0.0031*	0.0034+	-0.0036*
	[0.0011]	[0.0017]	[0.0010]
page^2/100	-0.0048*	-0.0061*	0.0013
	[0.0010]	[0.0017]	[0.0010]
page*m	-0.0016	-0.002	0.0004
	[0.0016]	[0.0024]	[0.0014]
page^2/100*m	0.0021	0.0028	0.0008
	[0.0016]	[0.0024]	[0.0014]
psex	0.0137*	0.0202*	0.0310*
	[0.0041]	[0.0066]	[0.0036]
psex*m	0.0111*	0.0149+	0.0054
	[0.0055]	[0.0084]	[0.0046]
visitdur	0.0395*	0.0474*	
	[0.0033]	[0.0040]	

visitdur^2/100	-0.1457*	-0.1700*	
	[0.0172]	[0.0206]	
visitdur*m	-0.0014	0.0003	
	[0.0039]	[0.0047]	
visitdur^2/100*m	0.0061	-0.0032	
	[0.0203]	[0.0249]	
Practice deprivation (ref. group: depcat4)			
depcat	Yes	Yes	Yes
depcat*m	Yes	Yes	Yes
Health board (ref. group: caid10)			
caid	Yes	Yes	Yes
caid*m	Yes	Yes	Yes
_cons	1.6412*	1.6841*	2.3256*
	[0.1077]	[0.1192]	[0.0957]
F	4585.01	1928.44	4621.09
r2	0.61	0.50	0.63
r2_a	0.61	0.50	0.63
r2_o	0.31	0.22	0.57
r2_w	0.61	0.50	0.63
r2_b	0.08	0.06	0.38
N	211080	137191	425142
N_g	261	261	264
g_avg	808.74	525.64	1610.39
F_fe	11.92	10.46	11.57
sigma_u	0.68	0.77	0.30
sigma_e	0.56	0.68	0.58
rho	0.59	0.56	0.21

For confidentiality reasons, we do not report coefficients on binary variables and responding interaction variables that are identified with small number of dentists, such as dentist contract (sal, sal*m), practice deprivation (depcat, depcat*m) and NHS Health Board (caid, caid*m).
Standard errors are in square brackets.
* significant at the 5% level.
+ significant at the 10% level.

6.3.1 Absolute difference: auxiliary OLS regression

So far, we implicitly assume that the treatments provided by migrant and non-migrant GDPs are identical after adjusting for observed heterogeneity across CoTs and dentist fixed effects. This is a standard assumption in the labour literature on internal migration, but it may not be suitable for our study where we compare migrant and non-migrant GDPs who were trained in different dental education system; assessing the absolute differences between treatments provided by migrant and non-migrant GDPs over time is also an interesting question to explore. In this section, we recover the coefficient of the migrant dummy, M_j, by estimating an auxiliary regression of the estimated dentist fixed effects, μ_j.

The distributions of dentist fixed effects for migrant and non-migrant GDPs that are estimated from Specification A are plotted in Figure 6.4. It shows that migrant GDPs on average have higher fixed effects than non-migrants GDPs (t-statistics=-6.2326, Pr(|T|>|t|)=0.0000). It should also be noted that there is more variation, as measured by the coefficient of variation, in the distribution of non-migrant fixed effects compared with the distribution of migrant fixed effects, despite the fact that migrant GDPs came from different training and experience backgrounds.

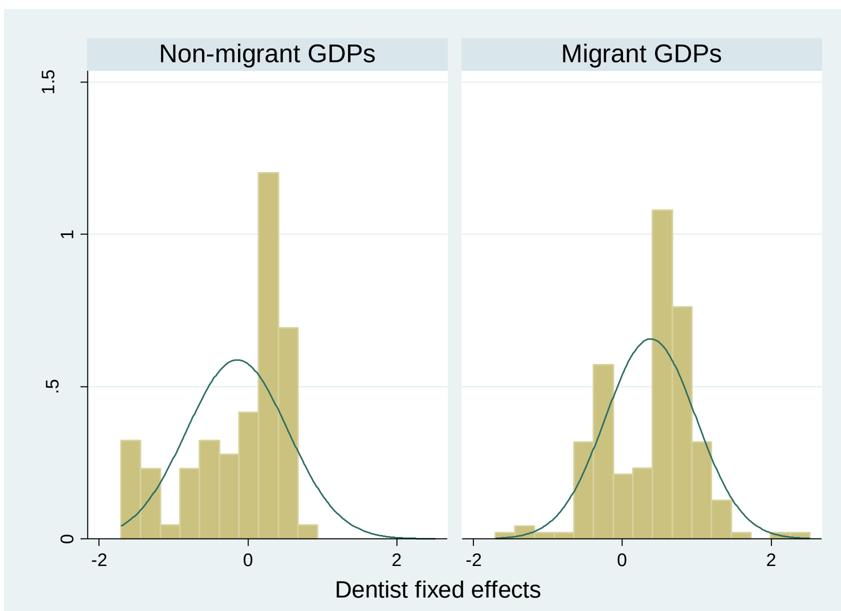


Figure 6.4: Distributions of dentist effects for migrant and non-migrant GDPs estimated from the dentist fixed effects specification.

Following Abowd, Kramarz and Margolis (1999), henceforth AKM, we recover the persistent effect of migrant status, α, by decomposing the estimated dentist fixed effects into two components:

$$\Psi_j = v_j + D_j\varphi, \quad (6.3)$$

giving a simplified version of Equation (6.2)

$$\ln(y_{ijk}) = X_{ijk}\beta + \Psi_j + \varepsilon_{ijk}, \quad (6.4)$$

where X_{ijk} is a set of all observable characteristics that vary across dentists and CoTs; Ψ_j measures persistent variation in treatment supply among dentists; v_j is the unobservable component of dentist fixed effects; and D_j is a vector of observable characteristics that is invariant or rarely changing for dentists over different CoTs. We can now capture the treatment difference between migrant and non-migrant GDPs using $E(\alpha + \delta_g)$ for each six months following entry.

The estimates of φ can be recovered using an auxiliary OLS regression by making an additional random effects assumption that v_j and M_j are orthogonal (AKM, 1999). This is generally a strong assumption in a sense that migrant GDPs may be motivated in a different way as compared with their native counterparts. However, since this study aims to measure the differences in treatments provided by migrant and non-migrant GDPs, regardless of whether this is due to M_j or v_j, and the extent to which such a differential arises from each component is beyond the scope of this chapter. The migrant coefficient could also be biased if the auxiliary regression omits variables that are simultaneously correlated with v_j and M_j (Plümper and Troeger, 2004). In this case, the estimated migrant effect can be composed of a number of components; the pure migrant effect, the part of the effect of v_j correlated with migrant status, and the part of the effect of v_j correlated with the omitted variable which happens to be correlated with M_j. We make the identification assumption that none of the observed variable excluded from the auxiliary regression is simultaneously correlated with v_j and M_j. This is reasonable given the rich set of explanatory variables we control for in the auxiliary regression.

As fixed effects methods only use time variations within each cross-sectional observation, between-variations for certain variables could also be taken up by the fixed effects (Cornelißen and Hübler, 2007). Thus the auxiliary regression includes time-invariant variables (e.g. the dentist's migrant status, age-at-entry and gender)[22], and also a set of variables that are rarely changing within each dentist (e.g. the dentist's contract (salaried or not), the deprivation category of the practice location, and the health board that the dentist worked in at the first treatment)[23]. Given the small number of dentists in the sample, we combine both the deprivation and health board categories that contain few dentists together to avoid collinearity. These variables are jointly significantly different from zero ($F(33,227)=247.89$, Prob>F=0.0000), and explain 74% of the variance of dentist effects obtained from the dentist fixed effects model (R-squared=0.74).

Table 6.5 presents coefficient estimates and robust standard errors of the auxiliary OLS regression. The coefficient on the migrant dummy suggests that, after controlling for observed variables that are invariant or rarely changing, a foreign GDP provides 11.47% more treatment than a comparable local trainee during the 2nd six months after entry, but this estimate is not statistically significant (P= 0.667). We find no significant variations by dentists' age-at-entry and gender. Again, dentist contract, practice deprivation and Health Board on entry have significant effects on dentist fixed effects, but cannot be reported due to confidentiality reasons.

[22] Time-invariant variables explain only 12% of the variance of dentist effects estimated.
[23] This assumes that characteristics of the dentist contract and their practice on entry have a persistent impact on their fixed effect.

Table 6.5: Estimation results of the auxiliary OLS regression.

Initial difference			
m	0.1147		
	[0.2662]		
Dentist characteristics			
enterage	-0.0003	enterage*m	-0.0028
	[0.0074]		[0.0083]
dsex	-0.0044	dsex*m	-0.0125
	[0.0392]		[0.0773]
Remuneration			
sal	Yes	sal*m	Yes
Grouped practice deprivation (ref. group: depcat4)			
depcat	Yes	depcat*m	Yes
Grouped health board (ref. group: caid5)			
caid	Yes	caid*m	Yes
_cons	0.3525+		
	[0.2117]		
F	247.89	r2	0.74
N	261	r2_a	0.70

For confidentiality reasons, we do not report coefficients on binary variables and responding interaction variables that are identified with small number of dentists, such as dentist contract (sal, sal*m), practice deprivation (depcat, depcat*m) and NHS Health Board (caid, caid*m).
Standard errors are in square brackets.
* significant at the 5% level.
+ significant at the 10% level.

6.3.2 Patient effects: two dimensional fixed effects specification

Another fundamental assumption of the dentist fixed effects specification is homogeneous patients. However, AKM (1999) emphasise the importance of personal and firm heterogeneities, in their case, in the compensation determination using French linked employer-employee data and assert that omitting either of these effects can give rise to *aggregation biases* and *omitted-variable biases*. When patient effects, u_i, are omitted, the estimated coefficients on the time-varying characteristics, β^*, equal the true coefficients, β, plus an omitted variable bias that depends upon the conditional covariance between X_{ijk} and u_i, given Ψ_j. The bias is generally nonzero as patients with certain characteristics (e.g., exempted from payment) may have different level of demand for treatment than others. And the estimated dentist fixed effect, Ψ_j^*, equals the pure dentist effect, Ψ_j, plus an aggregation bias which is made up of a weighted average of u_i for all patients who have ever been treated by dentist j, conditional on X_{ijk}. Thus, the migrant dentist effect recovered from the auxiliary regression of Ψ_j^*, can not only be related to the variations in treatment provision between the two types of dentists *per se* (the average of dentist effects), but also to the variations in treatment demand by the patients treated by them respectively (weighted average of patient effects). Given the different dentist contracts and distributions of practice deprivation, the patients treated by migrant and non-migrant dentists are likely to have different dental health and treatment demand, and thereby bias the estimates of migrant dentist effects.

Thus, we exploit the matched (patient and dentist) structure of the data, and consider a two dimensional fixed effects specification controlling for dentist effects and patient effects together. Consider a simplified version of Equation (6.1):

$$\ln(y_{ijk}) = X'_{ijk}\beta + \Theta_i + \Psi_j + \varepsilon_{ijk}, \tag{6.5}$$

$$\begin{cases} \Theta_i = u_i + P_i\tau, \\ \Psi_j = v_j + D_j\varphi, \end{cases}$$

where X'_{ijk} is a set of observable explanatory variables that vary across patient, dentist and different CoTs; Θ_i/Ψ_j measures persistent variation in treatment demand/supply among patients/dentists, which is arising from not only unobserved patient-/dentist-specific effects, u_i/v_j, but also observed variables that are invariant or rarely changing for patients/dentists over different CoTs, P_i/D_j. The random error, ε_{ijk}, is orthogonal to all explanatory variables, including μ_i and v_j. This assumption is standard in the applied econometric literature (AKM, 1999; Andrews, Schank, and Upward, 2006; Corneli ßen, 2006) and implies strict exogenous mobility by patients. This model produces consistent and unbiased estimates by explicitly allowing for observable and unobservable heterogeneity in both dimensions and unrestricted correlation among the effects.

The fixed effects method of estimating three-way error-component models was first introduced by AKM (1999), and developed in a more practical context by Andrews, Schank and Upward (2006). For researchers who are interested in consistent estimates of coefficients on observed time-varying variables (X_{ijk}), the practical and easy solution is the spell fixed effects method, which is essentially to time-demean within each patient-dentist combination. However, this method only allows the recovery of the sum ($\Theta_i + \Psi_j$), rather than each separately. On the other hand, for researchers who are also interested in obtaining consistent estimates of Θ_i and Ψ_j, the suitable solution would be to include dummy variables for the *j*-level heterogeneity and sweep out the *i*-level heterogeneity by the fixed effects transformation, called "FEiLSDVj" (Andrews, Schank and Upward, 2006). Since a particular concern of this paper is on the estimation of the dentist effects Ψ_j from which the migrant effect can be isolated, we implement the latter method using a memory saving Stata module "felsdvreg" written by Corneli ßen (2006).

The FEiLSDVj model places too great demand on our data to be well identified. Patient effects are identified by repeated observations on the patient, while dentist effects are identified by patients who change dentists during the sample period, called "movers". The two levels of effects can only be individually identified if patients move between dentists. In our case, treatment histories must be sufficiently connected: no dentist effects can be identified for dentists without movers. However, the nature of our analysis is such that acquiring such a sample might be difficult. The three-way error-component model needs representative information on dentists and patients. If we took a random sample of patients we would have fewer observations on the dentists we are interested in. To ensure there is no bias in terms of switching patients, we would have to identify all dentists who saw the patients treated by migrant and DVT GDPs during the sample period, whether or not they were migrants or DVT GDPs. We did this for a 5% random sample of all patients. The number of observations on migrant and DVT GDPs decreases to 13,922 and 5,344, respectively; but with 72,618 claims made on behalf of the same patients by other GDPs. These all suggest that while the three-way error-component model may be an option in principle, it may not be all that appropriate for the migrant analysis.

Our sample is generated by extracting all information on the two groups of GDPs we are interested in. On the patient dimension, we only take into account the treatments which are provided by each matching-dentist under observation, as any services provided by other dentists are not recorded. Table 6.6 gives an overview of the estimation sample. Patients in the sample have only 1.89 observations on average, with 55,947 out of 111,580 (50.1%) receiving treatment just the once and 103,779 (93.0%) staying with only one dentist. Andrews, Gill and Upward (2006) discuss the bias in the estimation of the correlation between firm effects and worker effects. They find in their study, a negative relationship between the bias and the number of movers, i.e. the higher worker mobility that each firm experiences, the less biased is the estimate. Based on this conclusion, Cornelißen and Hübler (2007) restrict their analysis to firms with at least 5 movers and workers with at least 2 observations. Following the same methodology, we generate a refined sample which includes 118,108 CoTs provided by 122 migrant and 50 non-migrant GDPs and to 42,854 patients in total. However, even though the refined sample excludes those dentists and patients for whom fixed effects are poorly estimated, estimates may still not be very precise, given the relatively small number of CoTs received by each patient (2.76) and of patients who changed dentists (7,689, or 17.94%) over the sample period.

Table 6.6: Identification of the two dimensional fixed effects models.

	Full Sample			**Refined sample**		
	CoTs	Patients	Dentists	CoTs	Patients	Dentists
	211080	111580	261	118108	42854	172
Identification of patient effects						
Obs. per patient:						
1	55947 (26.5%)	55947 (50.1%)		NA	NA	
2	59382 (28.1%)	29691 (26.6%)		46884 (39.7%)	23442 (54.7%)	
3	46356 (22.0%)	15452 (13.9%)		35037 (29.7%)	11679 (27.3%)	
4	25092 (11.9%)	6273 (5.6%)		18888 (16.0%)	4722 (11.0%)	
5+	24303 (11.5%)	4217 (3.8%)		17299 (14.6%)	3011 (7.0%)	
Identification of dentist effects						
Dentists per patient						
1	187106 (88.6%)	103779 (93.0%)		94441(80.0%)	35165 (82.1%)	
2	22272 (10.6%)	7409 (6.6%)		21985 (18.6%)	7303 (17.0%)	
3+	1702 (0.8%)	392 (0.4%)		1682 (1.4%)	386 (0.9%)	
Movers	23974 (11.4%)	7801 (7.0%)		23667 (20.0%)	7689 (17.9%)	
Movers per dentist						
0	10708 (5.1%)		33 (12.6%)	NA		NA
1-5	35870 (17.0%)		58 (22.2%)	3543 (3.0%)		8 (4.7%)
6-10	20968 (9.9%)		26 (10.0%)	14335 (12.1%)		25 (14.5%)
11-20	32299 (15.3%)		40 (15.3%)	19746 (16.7%)		38 (22.1%)
21-30	10849 (5.1%)		13 (5.0%)	7128 (6.0%)		11 (6.4%)
31-50	14834 (7.0%)		17 (6.5%)	9275 (7.9%)		16 (9.3%)
51-100	20278 (9.6%)		16 (6.1%)	16223 (13.7%)		16 (9.3%)
100+	65274 (30.9%)		58(22.2%)	47858 (40.5%)		58 (33.7%)
Groups						
1	199859	105734	224	117629	42650	168
2	436	350	2	323	134	2
3	77	66	2	156	70	2

For both samples, dentists with movers are divided into 3 “groups”, where each group is defined by patient mobility such that patients only receive treatment from dentists within the same group. Within each group, one dentist is arbitrarily selected as the reference with no dentist effect identified, and the other dentist effects represent the deviation from the reference. Therefore, dentist effects are not comparable across groups because dentists in different groups are characterised on different references. We base the corresponding auxiliary analysis of dentist effects on the largest group which contains 224 and 168 dentists in the two samples respectively, contributing 94.7% and 99.6% of total observations.

Table 6.7 presents results of fitting the two dimensional fixed effects specification on the full sample (Specification 2), and the refined sample (Specification 3) which yields relatively better identified coefficient estimates. Standard errors are corrected for both heteroskedasticity across patients and within-patient correlation using robust cluster variance estimation. For comparison, estimation results of the dentist fixed effects specification are also reported as Specification 1.

Table 6.7: Estimation results across specifications controlling for dentist effects, or both dentist effects and patient effects.

	FEj	**FEiLSDVj**	
	(1)	(2) full sample	(3) refined sample
I. Fixed effects regression			
Assimilation estimates (ref.: Exp_7-12)			
Exp_2-6	-0.0113	-0.0244+	-0.0230
	[0.0093]	[0.0138]	[0.0151]
Exp_13-18	0.0086	0.0156*	0.0154+
	[0.0071]	[0.0076]	[0.0086]
Exp_19-24	0.0156*	0.0225*	0.0281*
	[0.0077]	[0.0083]	[0.0093]
Exp_2-6*m	-0.0136	0.0028	0.0038
	[0.0148]	[0.0201]	[0.0201]
Exp_13-18*m	-0.0168	-0.0238+	-0.0280*
	[0.0114]	[0.0121]	[0.0121]
Exp_19-24*m	-0.0433*	-0.0413*	-0.0509*
	[0.0135]	[0.0136]	[0.0135]
Case mix			
prev	0.7393*	0.7688*	1.1192*
	[0.1319]	[0.1471]	[0.1890]
prev*m	0.0315	-0.1103	-0.4114
	[0.2011]	[0.2935]	[0.2908]
perio	0.6884*	0.6841*	0.6942*
	[0.0130]	[0.0086]	[0.0099]
perio*m	-0.0061	0.0345*	0.0226+
	[0.0177]	[0.0133]	[0.0134]
cons	1.1777*	1.1436*	1.1417*

	[0.0191]	[0.0092]	[0.0099]
cons *m	-0.0104	-0.0028	0.0017
	[0.0262]	[0.0135]	[0.0134]
surg	0.6270*	0.6051*	0.6032*
	[0.0157]	[0.0162]	[0.0169]
surg*m	0.0345	0.0496*	0.0607*
	[0.0215]	[0.0232]	[0.0225]
prosth	1.4709*	1.4619*	1.4493*
	[0.0262]	[0.0228]	[0.0236]
prosth*m	0.1124*	0.0787*	0.0995*
	[0.0372]	[0.0327]	[0.0315]
ortho	1.1838	1.8598+	2.2181+
	[0.8175]	[1.0029]	[1.1735]
ortho*m	0.8166	(dropped)	(dropped)
	[0.9958]		
other	0.0557+	0.0041	-0.0452*
	[0.0283]	[0.0167]	[0.0182]
other*m	-0.026	-0.0203	0.0234
	[0.0373]	[0.0239]	[0.0240]
occasional	0.6180*	0.3656*	0.3388*
	[0.0494]	[0.1068]	[0.1164]
occasional*m	-0.0795	0.0387	0.0328
	[0.0643]	[0.1315]	[0.1315]
incomplete	0.6061*	0.4934*	0.4904*
	[0.0854]	[0.0853]	[0.0806]
incomplete *m	-0.1447	-0.1274	-0.1405
	[0.0970]	[0.0985]	[0.0914]
misc	-0.0225	-0.0702+	-0.1082*
	[0.0196]	[0.0374]	[0.0510]
misc*m	0.0034	-0.0245	0.0163
	[0.0254]	[0.0552]	[0.0626]
trauma	0.1125+	-0.0090	0.0474
	[0.0681]	[0.1227]	[0.1266]
trauma*m	0.0633	0.1571	0.1449
	[0.0945]	[0.1907]	[0.2109]
Remuneration			
sal	Yes	Yes	Yes
sa1*m	Yes	Yes	Yes
exempt	0.0896*	0.1413*	0.1710*
	[0.0163]	[0.0354]	[0.046]
exempt*m	0.0206	0.0036	-0.0246
	[0.0211]	[0.0517]	[0.0576]
Patient characteristics			
page	0.0031*	-0.0213+	-0.0236+
	[0.0011]	[0.0123]	[0.0130]

page^2/100	-0.0048*	0.0104	0.0129
	[0.0010]	[0.0130]	[0.0138]
page*m	-0.0016	-0.0057	-0.0058
	[0.0016]	[0.0127]	[0.0118]
page^2/100*m	0.0021	0.0083	0.0077
	[0.0016]	[0.0135]	[0.0125]
psex	0.0137*		
	[0.0041]		
psex*m	0.0111*		
	[0.0055]		
visitdur	0.0395*	0.0473*	0.0407*
	[0.0033]	[0.0035]	[0.0039]
visitdur^2/100	-0.1457*	-0.1950*	-0.1688*
	[0.0172]	[0.0266]	[0.0288]
visitdur*m	-0.0014	-0.0001	0.0066
	[0.0039]	[0.0050]	[0.0050]
visitdur^2/100*m	0.0061	-0.0102	-0.0352
	[0.0203]	[0.0367]	[0.0365]
Practice deprivation (ref.: depcat4)			
Depcat	Yes	Yes	Yes
depcat*m	Yes	Yes	Yes
Health board (ref.: caid10)			
caid	Yes	Yes	Yes
caid*m	Yes	Yes	Yes
_cons	1.6412*		
	[0.1077]		
F	4585.01		
r2	0.61		
r2_a	0.61		
r2_o	0.31		
r2_w	0.61	0.57	0.57
r2_b	0.08		
N	211080	211080	118108
N_g	261	111580	42854
g_avg	808.74	1.89	2.76
F_f	12.15	1.10	1.13
F_fp		1.07	1.10
F_ff		2.54	2.71
sigma_u	0.68	0.55	0.56
sigma_e	0.56		
rho	0.59		
Cov(lf107,xb) / Var(lf107)		0.46	0.57
Cov(lf107,pfe) / Var(lf107)		0.24	0.14
Cov(lf107,dfe / Var(lf107)		0.14	0.06

Cov(lf107,res) / Var(lf107)		0.17	0.24
II. Auxiliary OLS regression			
Initial difference			
m	0.1147	1.7406+	1.6776
	[0.2662]	[1.0270]	[1.2356]
Dentist characteristics			
enterage	-0.0003	0.0456	0.0369
	[0.0074]	[0.0335]	[0.0433]
enterage*m	-0.0028	-0.047	-0.0384
	[0.0083]	[0.0352]	[0.0444]
dsex	-0.0044	0.1181	0.2037
	[0.0392]	[0.1813]	[0.2227]
dsex*m	-0.0125	-0.2728	-0.292
	[0.0773]	[0.2459]	[0.2717]
Remuneration			
sal	Yes	Yes	Yes
sal*m	Yes	Yes	Yes
Grouped practice deprivation (ref.: depcat4)			
depcat	Yes	Yes	Yes
depcat*m	Yes	Yes	Yes
Grouped health board (ref.: caid10)			
caid	Yes	Yes	Yes
caid*m	Yes	Yes	Yes
_cons	0.3525+	-1.1600	-0.9793
	[0.2117]	[0.9301]	[1.1756]
F	247.89	150.43	105.46
r2	0.74	0.86	0.83
r2_a	0.70	0.84	0.79
N	261	224	168

For confidentiality reasons, we do not report coefficients on binary variables and responding interaction variables that are identified with small number of dentists, such as dentist contract(sal, sal*m), practice deprivation (depcat, depcat*m) and NHS Health Board (caid, caid*m).
Standard errors are in square brackets.
* significant at the 5% level.
\+ significant at the 10% level.

Both types of unobserved heterogeneity are important in determining the treatment delivery. F-tests that patient effects and dentist effects are individually and jointly equal to zero are rejected on both samples – $F(111579,99212)=1.07$ & Prob>F=0, $F(225,99212)=2.54$ & Prob>F=0 and $F(111804,99212)=1.1$ & Prob>F=0 for Specification 2; $F(43022,75026)=1.1$ &Prob>F=0, $F(169, 75026)=2.71$ & Prob>F=0, and F(43022, 75026)=1.13 & Prob>F=0 for Specification 3). In particular, the patient-specific heterogeneity appears to play a relatively more important role than the dentist-specific. Dentist and patient effects estimated on the full sample account for 14% and 24% of the variation in treatment value, respectively ($Cov(y_{ijk}, \Psi_j)/Var(y_{ijk})$ = 0.14, $Cov(y_{ijk}, \Theta_i)/Var(y_{ijk})$ = 0.24). After excluding those dentists and patients for whom fixed effects are poorly estimated, the variations explained by fixed effects reduce to 6% for dentists and 14% by patients ($Cov(y_{ijk}, \Psi_j)/Var(y_{ijk})$ = 0.06, $Cov(y_{ijk}, \Theta_i)/Var(y_{ijk})$ = 0.14).

Following each specification of fixed effects estimates, coefficient estimates and robust standard errors of the auxiliary OLS regression are reported in Panel II of Table 6.7. Having accounted for patient effects, the explanatory ability of the auxiliary regression, as measured by the R-squared value, increases from 74% to 86% in the full sample, and 83% in the refined sample. Consistent with the dentist fixed effects specification, only the unreported dentist contract, practice deprivation and Health Board on entry have significant effects on dentist fixed effects.

The two dimensional fixed effects specification is required to estimate a patient fixed effects model including dentist dummies. Dentist-specific fixed effects therefore, may not be well identified given the small number of patients switching dentists over the short sample period of two years. The coefficient estimate of the migrant dummy in the auxiliary regression increases from 0.1147 (Specification 1) to 1.7406 (Specification 2). Given that the dentist effects specification attributes variation arisen from patient types to dentist effects, this could be indicative of lower fixed effects of patients registered with migrant GDPs compared with those with non-migrant dentists. However, the coefficient is apparent implausibly large, and it is likely due to the inaccurate identification of the two dimensional fixed effects model. Fitting on the refined sample makes no substantial difference, and the coefficient magnitude reduces very small (1.6776). Figure 6.5 illustrates the range of dentist effects estimated from the two dimensional fixed effects specification on both samples.

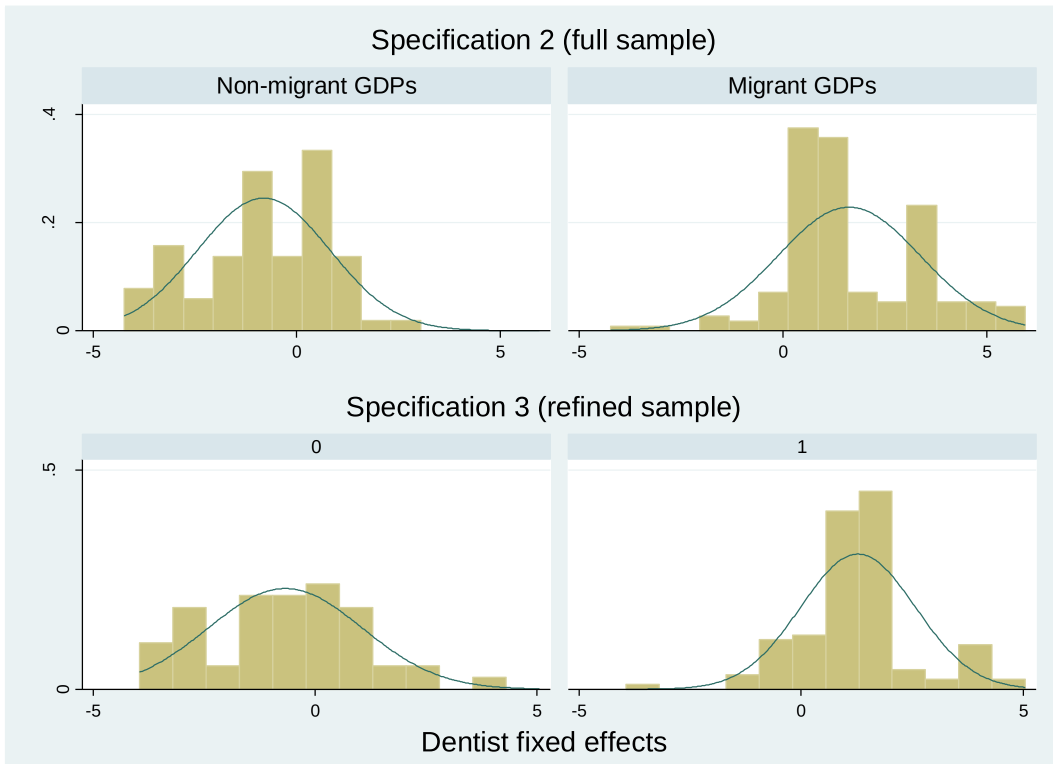


Figure 6.5: Distributions of dentist effects for migrant and non-migrant GDPs estimated from the two dimensional fixed effects specification on two samples.

Effects of variables with insufficient within-patient variations over the short sample period may also not be precisely determined. For example, patient age, exempt status, the practice deprivation and Health Board the patient resides in, and some particular treatment categories that that are either never or always, required by each particular patient (e.g. preventive, orthodontic, occasional, ‘incomplete’, ‘miscellaneous’ treatment, and treatment arose from trauma). Nevertheless, this is not the case for the main variables of interest.

Common treatment categories are generally estimated with very similar coefficients and significance when compared with the dentist fixed effects specifications, except ‘other’ treatment. Including patient effects induces a smaller effect of ‘other’ treatment, for which a possible explanation is that patients who receive ‘other’ treatment have higher patient effects than those do not. Furthermore, we find migrant and non-migrant GDPs deliver different treatment for various treatment categories after controlling patient effects: an F-test that interaction variables between migrant dummy and treatment category indicators are jointly equal to zero is rejected at the 5% of significant level on both samples (P=0.0210 and 0.0038). Besides prosthetic treatment indicated in the dentist fixed effects specification, migrant GDPs also provide significantly more treatment for periodontal and surgical treatment than a comparable non-migrant GDPs.

Finally, and most importantly, estimates of the interaction terms $Exp\_g_{ijk}M_j$ demonstrate a consistent assimilation process of migrant GDPs across specifications. Table 6.7 suggests the treatment difference reduces by similar amount during the period between the 7th and the 24th month (4.33%, 4.13% and 5.09%, respectively) and all at the 5% level of significance.

6.4 CONCLUSION

As a flexible and low-cost adjustment to temporary or regional imbalance, overseas qualified health professionals have made a significant and escalating contribution to health workforce in industrialized countries. This work, for the first time to our knowledge, evaluates the impact of international recruitment on the healthcare provision in the host country by comparing the treatment provided by migrant and non-migrant health professionals.

The treatments provided by all migrant dentists who started providing dental services in the service after 2006 are compared with the treatment provided by a comparison group consisting of the recently domestically trained dentists who subsequently worked in the GDS. A difference-in-differences model is estimated to examine whether migrant GDPs respond differently to case mix and individual circumstances (treatment category, patient type, remuneration, etc.), and after adjusting for observed variables and dentist fixed effects, how their treatment differences vary with time. Given the longitudinal nature of the data, we control for time-invariant unobserved heterogeneity in dentists using fixed effects method. Our results provide evidence that migrant GDPs have marginally different practice styles as compared to non-migrants. Compared with non-migrant GDPs with comparable characteristics, migrant dentists provide significantly different values of treatments only for patients who require prosthetic treatments and for male patients. In the dentist fixed effects model, the treatment difference at the reference experience category is eliminated together with dentist fixed effects and cannot be directly identified. Holding dentist fixed effects constant, there is evidence that their treatment difference diminishes with time spent in the GDS. Using the 2^{nd} six months of practice as the reference group, we find a consistent assimilation process across different specifications: the treatment differences reduces significantly by around 5% during the period from the 7^{th} to 24^{th} month.

The treatment difference at the reference experience category is also recovered by estimating an auxiliary OLS regression of estimated dentist effects against a set of variables that are time-invariant or rarely changing. We find migrant GDPs provide 11.47% more treatment than non-migrant GDPs during the 2^{nd} six months after entry, but this is not statistically significant.

The matched (patient and practitioner) longitudinal nature of the data also allows us to control more extensively for potential aggregation and omitted-variable biases by omitting persistent unobservable variations among patients, or patient effects than existing studies. This was done by estimating a three-way error-component model capturing unobserved heterogeneity in both patients and dentists. Our results suggest both types of unobserved heterogeneity play important roles in determining the intensity of individual treatment and should therefore, be controlled for together in the intensity function. However, dentist effects, as well as effects of certain variables, may not be very well determined given the small proportion of patients switching between dentists/variables during the two-year sample period. Fitting on a refined sample which excludes dentists and patients with poorly estimated fixed effects makes no obvious improvement. Nevertheless, the main variables of interest, such as assimilation estimates and treatment categories that are commonly delivered, are generally precisely estimated, and suggest a consistent assimilation process except that migrant GDPs provide significant different treatment on various treatment categories than non-migrant GDPs when controlling for patients' underlying dental conditions. Updating the sample with a longer sample period to allow for sufficient patient mobility is essential for better estimates in future research.

Treatment delivered by the two groups of GDPs is compared in terms of the total value of the CoT. In the realm of dental service, where in the presence of asymmetric information dentists have considerable discretion over the type of service they deliver, it is hard to decide whether the high value of treatment is of benefit to patients or simply financially motivated. It is not necessary that non-migrant GDPs provide the "standard" value of treatment, or better quality of service. However, as international recruitment becomes increasingly popular in OECD countries as a flexible and low-cost adjustment to temporary or regional workforce imbalance, it is clearly an important public concern to study if patients treated by migrant GDPs receive treatment at levels that are consistent with that provided by non-migrant GDPs or not is also an important public concern. Our findings do not show any evidence of this concern and suggest that migrant GDPs have marginally different practice styles as compared to non-migrants and exhibit significant convergence to their non-migrant counterparts during the first two years following entry.

CHAPTER 7

CONCLUSION

The migration issue has achieved prominence in health labour markets in recent years, especially within the European Union area since the May 2004 and December 2007 EU enlargements. In some developed countries, such as the United Kingdom for example, international recruitment has become an effective solution to short-term health workforce shortages. In this context, there has been growing interest in explaining and assessing the impact of health professional migration (Bach, 2003; WHO, 2006). This, however, has been rarely addressed in the health policy literature due to the general lack of data related to migrant health professionals. The research in this thesis begins to fill the gap by (1) examining the migration and permanent residence decisions of health professionals and the influcneses behind those decisions in a theoretical model framework; and (2) assessing the impact of health professional migration on the host country by investigating EEA dentist performance in the Scottish NHS using administrative data derived from the Scottish dental system.

To provide a systematic explantion for health professional migration, individual motivation needs to be recast to recognize the important role of institutions in generating and sustaining the movement (Bach, 2003; Commander, Kangasniemi and Winters, 2002; Manning and Sidorenko, 2007). The self-selection model by Borjas and Bratsberg (1996) provides an appropriate basis for our analytical framework, and it was therefore, extended in Chapter 3 to explicitly account for the strong sector-specific properties migrant health professionals have exhibited. Some of these include the investment motivation of professional development and training, and stringent regulatory regimes in the health sector. The extended model suggests that countries with higher international recognition for the health service delivery and training systems are in general more popular in the international health labour markets, while professionals' intention to remain permanently reduces when the duration of contracts and visas extends. We also exploited the effects of institution variables by assuming migration costs vary among professionals with different skill levels. Take the UK for example. The country-to-country campaigns may foster a further inflow of health professionals from targeted donor countries, while government intervention on permanent residence may be recommended to avoid a brain drain. In addition, the restrictive relicensing regime and the change of the immigration rules for non-EEA health professionals that are targeted to maintain practice standards and secure employment opportunities for native graduates, could actually limit the migration only from countries with higher returns to skills. However, this effect is ambiguous for most donor countries, which in general provide lower returns to skills.

The general policy suggestion is to adopt performance-based payment mechanisms and increase remuneration differences between grades in order to restrict the outflow of high-skilled native health professionals and the inflow of low-skilled foreign professionals. Alternatively, governments could achieve positive selection by reducing migration costs for high-skilled professionals by, for example, higher relicensing requirements and increasing competition in the labour market. Unfortunately, with the data available it is impossible to provide a more accurate and comprehensive assessment of influences on the size and skill composition of the migration flow. Collecting individual data of health professionals in donor countries is essential to develop empirical evidence and appropriate strategies for regulating and monitoring the migration of health professionals in future.

Having access to the administrative data derived from the Scottish dental system, we also examined the impact of health professional migration within EU on the host country by investigating the performance of dentists migrating from EC/EEA countries contracted under the Scottish NHS in terms of retention and treatment provision. In the retention chapter, we characterized the time trend of retention for EEA dentists in the Scottish GDS and identified factors associated with the likelihood of a dentist leaving the service using discrete-time proportional hazards modelling. Taking the sample of EEA nationals who entered the Scottish GDS during 1996-2005, we find half the EEA dentists had left the service by the 26th month following entry. Furthermore, the detailed data allow us to gain a better understanding of retention decisions by investigating a full range of potential determinants of retention duration that are rarely available in other datasets. The results indicate an inverse U-shaped relation between the hazard of leaving and time since entry, which peaks through the third practice year. We also find hazards of leaving the service are lower for migrants who join the service at around age 36, who arrive after 2003, and who treat less middle aged (around age 38) and male patients requiring more intensive treatment. The hazards are not associated with dentists' gender and original country, and practice deprivation.

These findings potentially help to set evidence-based targets for international recruitment programmes and identify those practices with difficulties in the dentist labour market. However, keep in mind of the limitations present in the data we have used, policy suggestions should be made with caution. Constrained by the small number of migrant dentists practising in Scotland, the reliability of the coefficients may not be high. We combined categorical variables and modelled the duration dependency using a quadratic function of time to preserve degrees of freedom, and estimated a series of specifications including various flexible baseline functions and unobserved heterogeneity distribution for robustness checks, which generally identified a common set of risk factors. A further concern is to what extent the entrants of 1996-2005 in our sample are representative of all EEA dentists in Scotland many of whom entered after a series of NHS access schemes launched since 2006. The endogeneity of dentist overall treatment provision in the retention decision is another issue which warrants further investigation using a large sample. Collecting a new sample including the latest entrants with a longer sample period is necessary for further investigation. On the whole, whilst this study focuses on EEA dentists working in the Scottish GDS and the data limit the policy implication of the work, our methodology can be applied on suitable data to address many retention issues for healthcare professionals.

In Chapter 6, we compared the output of migrant and non-migrant health professionals to evaluate the impact of international recruitment on the healthcare provision in the host country. This has never yet been attempted before to the best of our knowledge. We compared the treatment provided by all migrant dentists who started providing dental services in the GDS after 2006 with the treatment provided by a comparison group consisting of the 2005/06 cohort of Scottish DVTs. Given the longitudinal nature of the data, we estimated a difference-in-differences model controlling for time-invariant unobserved heterogeneity in dentists to examine whether migrant GDPs respond differently to case mix and individual circumstances (treatment category, patient type, remuneration, etc.), and how they assimilate into the host country. Our results suggest that, compared with non-migrant GDPs with comparable characteristics, migrant GDPs have marginally different practice styles, providing significantly different value of treatment only for patients who require prosthetic treatment and for male patients. The initial treatment difference at the reference (2nd) practice month cannot be identified in the dentist fixed effects model. Holding dentist fixed effects fixed, there is evidence that their treatment difference diminishes with time spent in the GDS.

As international recruitment becomes commonly used within OECD countries as a flexible and low-cost adjustment to temporary or regional imbalance, whether patients registered with migrant and non-migrant healthcare professionals receive consistent services is clearly an important concern. Our findings provide evidence that there is significant convergence in practice style of migrant and non-migrant dentists over time during the first two years following entry.

The treatment difference at the reference practice month is also recovered by estimating an auxiliary OLS regression of dentist effects estimated against a set of variables that are time-invariant or rarely changing. We find migrant GDPs provide 11.47% more treatment than non-migrant GDPs during the 2^{nd} six months after entry, but this is not statistically significant. Another concern is the potential aggregation and omitted-variable biases by omitting persistent unobservable variations among patients, or patient effects. The matched (patient and practitioner) longitudinal nature of the data allows us to control more extensively than existing studies. We estimated a three-way error-component model capturing unobserved heterogeneity in both patients and dentists. Our results suggest both types of unobserved heterogeneity play important roles in determining the intensity of individual treatment. However, we acknowledge that the two dimensional fixed effects model may not be very well determined given the relative small proportion of sample patients switching between dentists. Although the estimation sample is refined by excluding dentists and patients with poorly estimated fixed effects to improves estimation, updating the sample with a longer sample period to allow for sufficient patient mobility is essential for better estimates in future research.

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